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РЕЗЮМЕ

НАСЛЕДОВАНИЕ ТИПА КАРОТИНОИДОВ В КУКУРУЗЕ

А. ФАЛУДИ-ДАНИЕЛЬ, Ф. ЛАНГ, А. НАДЬ, Б. ФАЛУДИ

Изучалось наследование нарушения синтеза каротиноидов в штаммах кукурузы с хлоропластидной мутацией, накопляющих каротин или ликопин.

Результаты анализирующих скрещиваний показали, что фактор образования β-каротина рецессивный-эпистатический по отношению к фактору формирования ликопина.

Соотношения расщепления оказались независимыми от направления скрещивания.

Эпистатическое влияние фактора β-каротина подтверждает соображения, согласно которым β-каротин служит предшествующим веществом и ликопина и β-каротина.

ТЕРМО-ФИЗИОЛОГИЧЕСКИЕ ИССЛЕДОВАНИЯ ВСАСЫВАНИЯ И ПРОРАСТАНИЯ СЕМЯН НЕКОТОРЫХ АРИДНО-ТЕРРИТОРИАЛЬНЫХ РАСТЕНИЙ

У. Н. ЧЕТТЭРДЖИ, КЭМЭЛ МОНОТ

Mimosa hamata Willd. один из типичных аридно-территориальных видов, заселяющих пустыню Райастан. Поглощение стало заметным только в небольшой мере, до 5 — 15 процентов, когда семена были помещены в воду в лабораторных условиях. Для прорастания семян оптимальной температурой оказалась t° 35° С. При такой температуре процент прорастания был 55. Невысокие температуры (3° 10° С) ни в какой мере не способствовали прорастанию.

Переменные или высокие температуры, как предварительные обработки, повысили проницаемость и прорастание семян. Высокие аридные температуры (60, 70, 80° С), применённые в течение 24 часов, оказались более эффективными, процент всасывания и прорастания был 87—89 и 89—92.

Аридная температура 90° С действовала благоприятно, если применялась в течение одного часа; в этом случае был получен 81% прорастания, который был максимальным.

Семена, подвергнутые аридной температуре при 100° С, хоть только на полчаса, показали небольшое прорастание (15%). При попытке сделать вывод между корреляциями влияний лабораторных и естественных условий на проницаемость и прорастание семян, мы прошли к выводу, что твёрдосемянность — один из способов приспособления к среде.

ДАННЫЕ К ВОПРОСУ О ТРАНСПОРТИРУЮЩИХСЯ АМИНОКИСЛОТАХ ПШЕНИЦЫ, КУКУРУЗЫ И РИСА И О РОЛИ ОРНИТИНА

Л. ДЕЖИ, М. БАРКОЦИ, Г. ПАЛФИ

Было изучено количество и состав аминокислот в пасоке пшеницы, кукурузы и риса в фазе цветения. Было установлено, что в пасоке из числа транспортирующихся аминокислот в наибольших количествах встречаются глютамин, аспарагин, орнитин и серин, у риса к ним следует ещё добавить аланин. Характерной аминокислотой пасоки является орнитин, который был найден нами только в корнях. Можно полагать, что орнитин является специфической составной частью энзимного белка, регулирующего транспорт веществ из корней к побегам. Наиболее высокие концентрации аминокислот наблюдались в пасоке кукурузы, а наиболее низкие у риса. В то же время наибольшее количество аминокислот удалось выявить в пасоке риса.

РАЗВИТИЕ МЕТЁЛКИ РИСА

С. П. БЕНЭРДЖИ, П. К. БАУМИК

Цель этого исследования было получить подробные данные развития метёлки риса. Одновременно были сделаны попытки установления корреляции между стадиями, размерами точки роста и другими морфологическими признаками. Развитие целиком было классифицировано на 24 стадии. Эта классификация основывалась на микроскопическом изучении точки роста и на определении распознаваемых изменений морфологических признаков. Мы пришли к выводу, что рост точки роста и метёлки зависит от определенных стадий развития.

ИЗУЧЕНИЕ ОПЛОДОТВОРЕНИЯ ПРИ РАЗЛИЧНОЙ СТЕПЕНИ УДАЛЕНИЯ ЧАСТЕЙ ПЕСТИКА

Дь. ПАЛ, Ж. ОСВАЛЬД

У баклажана — ***Solanum melongena L.*** удалялись участки пестика ***(pistillum)*** различной величины, а именно: рыльце, половина столбика и весь столбик. Пыльца была нанесена на поверхность среза. При ранении пестика в зависимости от сорта завязываются плоды и формируются фертильные семена. В случае трудно скрещивающихся сортов удаление пестика, то есть исключение необходимости длинного роста пыльцевых трубок, а также и ингибиторов столбика скрещиваемость улучшается по сравнению со скрещиванием при неповрежденном пестике повышается процент завязывания и число семян в плоде. В других случаях при удалении участков пестика различной величины, при сокращении пути пыльцевой трубки снижается завязываемость и число семян в плоде.

ИЗУЧЕНИЕ ОРГАНОГЕНЕЗА И СИНТЕЗА БЕЛКОВ В НЕСТАБИЛЬНОЙ КУЛЬТУРЕ ТКАНЕЙ МЕЖВИДОВОГО ГИБРИДА NICOTIANA ОБРАЗУЮЩЕГО ОПУХОЛИ

Э. И. КОВАЧ

Культура тканей была получена из вторичной опухоли, найденной во втором поколении гибрида тетраплоидного **Nicotiana rustica** и **N. glauca**. Культура тканей состоит из участков тканей, потенциально способных для органообразования и участков не способных на это. Эти два типа тканей можно размножать и отдельно (зачатки побегов и неорганизованный каллюс). При размножении они сохраняют свои оригинальные особенности в отношении органогенетической способности. Оба типа тканей хорошо растут и на среде не содержащей ауксина и кинетина. Интенсивность синтеза белка в нестабильных культурах в зачатках побегов только в четырех и шестинедельном возрастах выше, чем в частицах недифференцированного каллюса. Можно полагать, что в усилении синтеза белка играют определенную роль и вторичные влияния (напр. синтез белков в связи с процессами удлинения клеток).

ВЛИЯНИЕ АЗОТНОГО УДОБРЕНИЯ НА УРОЖАЙ СУХОЙ МАССЫ И НА АЗОТНЫЕ ФРАКЦИИ СОРГО В РАЗНЫХ СТАДИЯХ РОСТА

А. Е. ЮНИС, К. А. АГАБАВИ

С целью определения реакции **Sorghum vulgare** на влияние возрастающего азотного удобрения был поставлен опыт в 4-х повторностях со случайным роспределением. Результатом применения азотного удобрения было возрастание содержания белка корма и урожая. В 1962 году, под влиянием 140 lb N/**feddan**, урожай сырого белка утроился. Неперерывно снижалось общее количество белка и белкового азота на единицу сухой массы. В результате применения азота эти фракции возрастали во всех стадиях роста, но белковый азот, как часть общего белка, в процентах показал отрицательную корреляцию с дозами азотного удобрения.

Селитра и другой азот составляли значительную часть содержания небелкового азота сорго в стадиях прорастания и кущения. Аммиак и амиды находились в них в сравнительно невысоких количествах. Селитра оказалась главной формой азота, полученной из почвы. В стадии цветения размер селитро-азотной фракции сократился и поэтому предлагается использовать его для потребления корма в этой стадии роста.

УСЛОВИЯ ОПЛОДОТВОРЕНИЯ СОРТОВ ЯГОДНЫХ РАСТЕНИЙ

III. Малина, черная и красная смородина

А. ШЕЛЯХУДИН, Ш. БРОЗИК

Малина. Изученные 14 сортов малины являются самоопылителями. Повышенный процент завязывания при свободном опылении (40—90%) доказывает необходимость наличия сортов опылителей. Склонность к партенокарпии у малины выражена слабо (1—2%).

Черная смородина. Склонность к самоопылению у 21 изученного сорта различная. Практически самостерильными сортами являются: **Baldwin, Boskoop Giant, Lees** черная и **Wellington.** Остальные изученные сорта самофертильны в размере 20—80%. Свободное опыление обычно приводит к повышенному завязыванию плодов. Партенокарпия и апомиксис также наблюдаются, особенно у сорта **Goliath (F).**

Красная смородина. Склонность к самооплодотворению у 14 изученных сортов различная. Завязывание при свободном опылении, достигающее 80—90%, говорит о том, что при использовании соответствующих сортов опылителей достигается повышенный урожай. Склонность к партенокарпии у сортов красной смородины очень слабая.

ДАННЫЕ ОТНОСИТЕЛЬНО ВОЗМОЖНОСТИ БОРЬБЫ С ВИРУСАМИ КАРТОФЕЛЯ

III. Испытания голландским методом

Й. ХОРВАТ

В ходе испытаний голландским методом было установлено, что зараженность вирусами **BXV** и **BSV** не снижалась по сравнению с контрольными делянками и по отдельным сортам наблюдалось даже некоторое повышение зараженности вирусом **BSV** (Гюлбаба, Кишвардаи рожа, Шомоди кораи, Шомоди шарга).

В отношении урожайности — которая сильно снизилась и ввиду исключительно засушливой погоды — было установлено снижение на 57,6% по сравнению с контролем, если ботва выдергивалась в оптимальные сроки (12. июля).

УСЛОВИЯ ОБЕСПЕЧЕННОСТИ МИКРОЭЛЕМЕНТАМИ НЕКОТОРЫХ БОЛОТНЫХ ПОЧВ ВЕНГРИИ

Д. ДЬЁРИ

Определялось общее содержание некоторых микроэлементов в болотных почвах Венгрии и количество подвижной фракции. Проводились определения марганца, меди, цинка и молибдена, а также и содержания обменивающегося магния.

Было установлено, что наши болотные почвы характеризуются высоким содержанием обменивающегося магния и вероятно не требуют применения магниевых удобрений. Эти почвы содержат среднее количество марганца, но подвижного марганца мало, поэтому внесение марганцевых удобрений обосновано.

Болотные почвы содержат мало меди, подвижной меди очень мало, внесение меди необходимо. Болотные почвы у нас содержат достаточные количества цинка, поэтому вносить этого элемента не следует по нашему мнению. Венгерские болотные почвы содержат высокие количества молибдена, что проявляется в высоком содержании этого элемента в болотно-луговом сене. Высокое содержание молибдена вызывает токсикоз крупного рогатого скота, что ещё усугубляется низким содержанием меди. По данным наших анализов орошение не влияло на содержание подвижных микроэлементов почвы.

ИЗУЧЕНИЕ ТЕРПЕНОИДА В РАЗЛИЧНЫХ ЧАСТЯХ РАСТЕНИЯ CORIANDRUM SATIVUM L.

I. Исследование эфирного масла в стенках плода и проростках сорта «Луч» с помощью тонкослойной хроматографии

Ж. ЛАШШАНИ, Ц. ЛЁРИНЦ

С помощью тонкослойной хроматографии изучалось эфирное масло, полученное при водно-паровой дестиляции из проростков и стенок плода после проращивания у сорта «Луч», (**Coriandrum sativum L.**) Установлено, что эфирное масло проростков линалоола не содержит. Содержание линалоола в эфирном масле стенок плодов не изменяется и после проращивания.

ПЕРИОДИЧЕСКИЙ ПОСЕВ СОРТОВ ЯЧМЕНЯ

Э. ПОЛЛХАМЕР

В 1962, 1963 и 1965 гг. в еженедельных посевах изучены урожай и важнейшие признаки семи сортов ячменя. В более поздних посевах наблюдалось понижение урожая и различных показателей изученных признаков. Сорта по-разному реагировали на изменение среды, вызванное периодическим посевом. По срокам посева, годам и сортам разные элементы урожая или признаки проявляли решающее значение. Вообще сильно варьировали признаки: число побегов и колосьев на растение; только слабо варьировали: абсолютный вес, длина колосьев и высота растений. Полученные данные пригодны для характеристики разных сортов.

ПОТРЕБЛЕНИЕ ПИЩИ ЛЮЦЕРНОВЫМ ДОЛГОНОСИКОМ

Hypera (Phytonomus) variabilis Hrbst. (Coleoptera, Curculionidae)

ДЬ. ШАРИНГЕР

В статье описываются результаты лабораторного изучения потребления пищи личинок и взрослых **Hypera variabilis Hrbst.** Личинкам требовалось 28,5 мг зеленых листьев люцерны за период развития, что соответствует 2,6-кратному весу развитой личинки. Личинки увеличили свой оригинальный вес ($Л_1 = 0{,}05$ мг) в 210 раз к концу своего роста ($Л_3 = 19{,}5$ мг), а затем к моменту окукливания они потеряли 7,6% своего максимального веса.

Долгоносики с момента выкукливания до ухода в зимний покой (диапауза) потребили еще 338,6 мг зелёных листьев. Это количество в 33,8 раз больше оригинального веса жучка, выходящего из фазы куколки.

ПОЛУЧЕНИЕ ТРИПЛОИДНОГО АРБУЗА И ОПЫТЫ ПО ЕГО ВЫРАЩИВАНИЮ

А. КИШШ

Работа по получению триплоидного (бессемянного) арбуза нами была начата в 1959 г. Обработкой колхицином было получено около 50 тетраплоидных форм из сортов Дью Грин, Роуд Айлэнд Ред, Нью Хемпшир Миджет, Ашахи и Шугер Бэби (семена предварительно были замочены в воде в течение суток, а затем в 0,5%-ном растворе колхицина в течение 48—52 часа). Тетраплоиды затем были скрещены со своими диплоидами и другими диплоидными сортами. Было получено 22,8% фертильных семян триплоидов, но только в том случае, если тетраплоидная форма использовалась в качестве матери. Производственные результаты в опытах 1963 г. были ещё неудовлетворительные, но в 1964 г. уже удалось добиться 50%-ной всхожести. В 1965 г. были получены хорошие результаты, несмотря на крайне прохладную погоду. Триплоидные арбузы были высококачественными, но их выращивание стоит дорого. Для экспортных целей их производство оправдывается.

ИЗУЧЕНИЕ ВЫДЕЛЕНИЯ ЭФИРНОГО МАСЛА В VALERIANA COLLINA WALLR С ПОМОЩЬЮ СВЕТОВОГО МИКРОСКОПА

II. Гистохимические исследования

Р. Г. СЕНТПЕТЕРИ, Ш. ШАРКАНЬ, Л. ФРИДВАЛСКИ, Й. НАДЬ

Изучались состав покрывающего слоя эфиро-масличных тел, выделяющихся из корневых тканей Valeriana collina, на основании их растворимости и цветных реакций т.е. изменения, наступающего в процессе старения ткани.

Разработана очень чувствительная цветная реакция, которая является специфической для эфирных масел. С помощью этой реакции прослежен процесс выделения эфирного масла с самого его начала.

ДАННЫЕ ОТНОСИТЕЛЬНО НАКОПЛЕНИЯ СУХИХ ВЕЩЕСТВ В РАЗЛИЧНЫХ ЯРУСАХ СТЕБЛЯ И ЛИСТЬЕВ РАСТЕНИЙ КУКУРУЗЫ

М. ПЕТЁ

Изучалось содержание сухих веществ в различных ярусах междоузлий и листьев гибридной кукурузы Мартонвашари I в период от выхода в трубку до наступления молочной спелости. Накопление сухих веществ в ярусах усиливается по направлению к верхушке. В фазе молочной спелости содержание сухих веществ выше и увеличивается акропетально. При задержке формирования зерен содержание сухих веществ в вегетативных органах ниже. Накопление сухих веществ в вегетативных органах связано с размещением женских соцветий и состоянием развития последних.

СРАВНЕНИЕ ГЛАВНЫХ ПРИЗНАКОВ ГИБРИДОВ С ЦИТОПЛАЗМАТИЧЕСКОЙ МУЖСКОЙ СТЕРИЛЬНОСТЬЮ И ИХ ФЕРТИЛЬНЫХ АНАЛОГОВ

М. НАДЬ

В 1963 г. в Краснодаре проводилось сравнительное изучение 127 пар стерильных и фертильных аналогов, с целью определить эффект цитоплазмы с мужской стерильностью. Сравнивая гибриды, полученные с участием форм с цитоплазматической мужской стерильностью, с гибридами их фертильных аналогов было выяснено, что первые являются более продуктивными. Сами растения, также как и их междоузлия, особенно те, которые расположены выше початка, стали короче, хотя число их узлов едва отличалось от числа узлов аналогов, фертильных гибридов. Определено также, что эффективность плазмы с мужской стерильностью проявлялась на ранней стадии развития индивидуального растения; более того, дегенерация и стерильность мужских половых органов не являлись единственными результатами этого.

Общих закономерностей еще нельзя вывести на основе этих опытов, но результаты их могут быть использованы для иллюстрации рассмотренных изменений использованного советского гибридного материала.

СООТНОШЕНИЕ СЫРОГО БЕЛКА И СЫРОЙ КЛЕТЧАТКИ В ЛЮЦЕРНЕ И СОЕ

З. КУНФИ, М. ФАРКАШ

Авторы исследовали соотношение сырого белка и сырой клейковины в зеленых кормах бобовых в 1955—57, 1961—62 гг., в первую очередь в люцерне и сое, чтобы определить, существует ли корреляция между ними. Если эта корреляция существует, то достаточно в лаборатории определить сырой белок; длительное определение сырой клейковины, требующее большой затраты труда можно было бы не проводить.

ДАННЫЕ ПО ФАРМАКО-БОТАНИЧЕСКОМУ ОПИСАНИЮ DATURA METEL L. VAR. MURICATA (BERNH.) DANERT В УСЛОВИЯХ ВЕНГРИИ

Г. ВЕРЗАР-ПЕТРИ

Автором описано развитие морфологических признаков и органообразования у хорошо известного варианта оригинального растения **Datura metel** (var. muricata [Bernh.] Danert) в течение вегетации. Было определено содержание общего алкалоида и алкалоидный спектрум по органам в разные фазы развития. Изучался также спектр свободных аминокислот этого растения. Содержание аргинина, орнитина, пролина, глютаминовых кислот и фенил-аланина, играющих роль в биогенезе тропан-алкалоида, сравнивалось с онтогенетическим ритмом содержания алкалоидов.

БИОЛОГИЧЕСКАЯ ЦЕННОСТЬ СЕМЯН ОЗИМОЙ ПШЕНИЦЫ, УБРАННОЙ В РАЗНОЕ ВРЕМЯ

П. ВИГЛАШИ, Б. НАДЬ

Летом 1965 г. у трех сортов озимой пшеницы Безостая I, Карцаги 344 и Карцаги 522 через неделю после колошения, а затем через каждые четыре дня вплоть до уборки срезались колосья, чтобы определить биологическую ценность семян, убранных в разное время.

Данные опыта показали, что семена озимых пшениц Безостая I и Карцаги 344 уже при абсолютном весе 3,41 и 3,78 г прорастали на 75—86%, а сорт Карцаги 522 не прорастал еще при абсолютном весе 3,53 г. За три недели до полного созревания сорта достигли полной биологической зрелости.

СВЯЗЬ РОСТА ПЛОДОВ И ЦВЕТЕНИЯ У ДЫНИ

Л. БАКШАИ

У четырех сортов дыни изучалась связь роста плодов и цветения. Рост плодов происходит по сигмоидной кривой. Появление и оплодотворение первых гермафродитных цветков совпадает с начальной дифференциацией гермафродитных цветков, появляющихся на две недели позже первых. Когда заканчивается фаза быстрого развития молодых плодов у верхней инфлекционной точки сигмоидной кривой, начинается более интенсивное цветение, второе завязывание плодов. С этого времени в течение 1—2 недель происходит гибель мелких плодов, в то же время первые плоды находятся в процессе медленного роста и созревания и возможно, что создавшийся к этому времени гормональный уровень приводит к массовой гибели плодов. После удаления развитых плодов, плоды оставшиеся от второго оплодотворения или обреченные на медленное развитие плоды первого оплодотворения совершают те же фазы развития, как и первые.

ВЛИЯНИЕ ВЛАЖНОСТИ ПОЧВЫ НА РОСТ И АБСОРПЦИЮ ПИТАТЕЛЬНЫХ ВЕЩЕСТВ У ВИНОГРАДА

К. ШИМОМУРА

У сорта винограда «Делаваре» с сокращением влажности почвы интенсивность ассимиляции, цветения, удлинение стеблей и прибавление веса растений и ягод снижаются.

При внезапном повышении температуры, после дождливой погоды — за исключением наименьшей влажности почвы — листья, особенно нижние опадают.

Соотношение Mg к N, P, K и Ca также изменяется в сторону уменьшения по мере сокращения влажности.

В динамике изменения размера ягод имеется суточный ритм, днём меньше, ночью больше. Разница больше при сокращенной влажности почвы.

РОЛЬ СРЕДЫ И ОТБОРА В ПРОЦЕССЕ ПРЕВРАЩЕНИЯ ЯРОВОЙ ПШЕНИЦЫ В ОЗИМУЮ

Ш. РАЙКИ

В опытах по превращению яровой пшеницы в озимую, проводившихся в течение последних десяти лет, во всех трех циклах опыта постоянной проверкой исходных и подопытных растений с помощью контрольных скрещиваний, комбинированных с проверкой по потомству — в полном соответствии с генетическими, физиологическими и биохимическими анализами, неприведенными в этой работе, доказано следующее:

а) Исходный материал опытов, линии и подлинии сорта пшеницы Л 62 оказались генетически яровыми и не содержат в себе видимых или скрытых форм полуозимой или озимой пшеницы.

б) В генетически чистом исходном материале ярового типа постепенное генетическое превращение, адекватное качеству и количеству осенних репродукций, вариация повторно установленная в свойствах озимости-яровости, является результатом воздействия среды, а не отбора.

Это утверждение полностью совпадает со взглядами Дарвина (1892), возражавшего против тех авторов, которые воображают, «что естественный отбор вызывает изменчивость». В то же время он подчеркивает, что отбор «лишь сохраняет такие изменения, которые возникают и оказываются полезными существам, обладающим ими, при данных жизненных условиях».

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THE INHERITANCE OF CAROTENOID TYPES IN MAIZE

By

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The inheritance of carotenoid abnormalities in the chloroplast mutant maize strains accumulating ζ-carotene or lycopene was investigated.

The results of crosses show that the ζ-carotene factor is in a recessive epistatic relation with the allele forming the lycopene character.

The proportions of segregation are not influenced by the direction of crossing.

The epistatic effect of the ζ-factor supports those conceptions according to which the ζ-carotene is the precursor of both the lycopene and β-carotene.

Introduction

The chromosomes contain much information about the carotenoid synthesis of maize grains (DE HAAN 1933). A special group of genes regulating carotenoid formation effects both the endosperm and the embryo and thus the homozygotic recessive plants develop mutant chloroplasts. These chloroplasts represent different types of albinism as a direct or indirect result of the blocking of carotenoid formation.

ROBERTSON (1961) gives detailed data on the genetical localization of 13 alleles belonging to this type: $vp_2\,vp_5$, vp_9 (viviparous), *ps* (pink scutellum), w_3, w_{7748} (white), lw_1, lw_2, lw_3, lw_4, (lemon-white), cl_1 (chlorophyll-mutant), pas_{8549} (pastel) and *al* (albescens) but we do not possess detailed information on their metabolic action.

From the description of the mutants (ROBERTSON 1952, 1955) it appears that the vp_2, vp_5, vp_9, *ps* and w_3 factors also cause the omission of the dormancy of the grains, producing, vivipary. The vp_9, w_3 and *pas* genes (pas_{8549}, pas_{4889}, pas_{8686}) depending on the temperature cause a 10—80% reduction in carotenoid content and a 10—50% reduction in chlorophyll content (RICHARDSON—ROBERTSON—ANDERSON 1962). The *ps* mutant is pink and ROBERTSON (1955) according to his exploratory examination obtained chromatograms having a pigment composition with essential qualitative differences to the normal.

Regarding the physiological effect of the w_3 factor it is known that after phytoene it blocks carotenoid synthesis (ANDERSON—ROBERTSON 1960). The action of the w_3 gene is not significantly affected by the genetical background (LIU—EVERETT 1965). This mutant forms protochlorophyll in an identical

amount with the normal (KOSKI—SMITH 1951) which produces chlorophyll in the light but soon suffers photodestruction. TULPULE (1954) found that the *lw* genes (lw_1, lw_2, lw_3, lw_4) only quantitatively affect carotenoid formation. The chlorophyll content of the *lw* plants is 20—30% that of the normal (SMITH—DURHAM—WURSTER 1959). The cl_1 gene in the homozygote state similarly to the *lw* factors reduce the carotenoid concentration of the endosperm and accompanies albino seedling formation. The cl_1 factor is allelic with the cl_S suppressor series whose members do not influence the color of the endosperm, and bring about quantitative differences in the pigment content of the leaves (ROBERTSON 1964). We have no data on pigment synthesis characteristic of the w_{7748} factor. It is known about the *al* mutant that it is manifest in stripes on leaves and depending on their relative quantity lethal, sublethal or surviving plants are produced (PERRY—SPRAGUE 1936).

In our previous work we found only ζ-carotene and lycopene in the grains of mutants slightly different from those strains already described (F. DÁNIEL—LÁNG 1965).

At a light intensity of 20—30 lux optimal for the ζ-carotene mutants, mechanically delicate chloroplasts with very low chlorophyll content and with the same number as the normal ones are formed in the leaves. These also accumulate ζ-carotene. Among similar conditions we can find in the lycopene strains a reduced number of chloroplasts with lycopene and a relatively higher concentration of chlorophyll (F. DÁNIEL—DUBRAVICZKY 1967). In these mutants the stability of the pigment-protein complex is reduced (F. DÁNIEL—LÁNG 1964) and reflecting in their fluorescence spectra the aggregation of the pigments also differs from the normal (F. DÁNIEL—FRADKIN—LÁNG 1966). We determined that activity of the ζ and *ly* factors influencing carotene synthesis quantitatively differs in the endosperm and in the embryo (F. DÁNIEL—LÁNG 1965).

In the present work we have examined the interaction of factors blocking carotene synthesis after ζ-carotene and lycopene in the offspring population of their heterozygotes.

Material and Methods

The origin of strains. The ζ-carotene accumulating maize strain is from E. PAP (Agricultural Research Institute of the Hungarian Academy of Sciences, Martonvásár). It spontaneously occurred in inbred populations. It shows a great degree of vivipary though dependent on ecological conditions. Since it accumulates only ζ-carotene it cannot be identified with any one of the mutants described in the literature on the basis of its metabolic effect.

The strain synthesizing lycopene is a gift of A. BIANCHI (Italy) and it is also a result of spontaneous mutation. It most closely resembles *ps* among the mutants described in the literature, but it is different from it in that carotenoid aberration in our strain does not occur together with vivipary.

Since 1958 we have been inbreeding the experimental material and the segregation ratio was found to be 3 : 1 for both factors.

Since we wanted to study the interaction of factors influencing carotenoid synthesis the two strains were crossed. On account of the lethality of the homozygotic recessives, normal (homozygotic dominant and heterozygote) grains were sown from both strains. According to the outline seen in Fig. 1 only the individuals producing at least two ears were used for crossing.

Half of the pollen from one plant was put on the female inflorescence of one individual from the other strain, while the second half was used to fertilize one of its own female flowers. Reciprocal crosses were also made.

Thus one of the ears from the plants was gained by self-pollination — which served to determine the genotype of the mother plant — while the other was the result of crossing.

When inbreeding the plants gained by crossing we deduced from the segregation ratio the genotype of the individual plants or rather the relation between the factors which we statistically described with the χ^2 test.

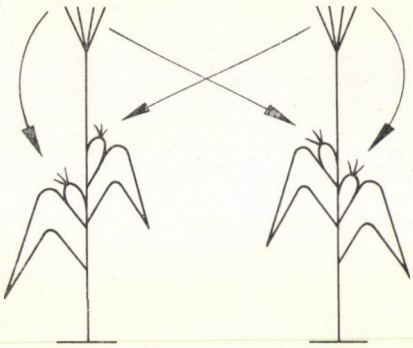

Fig. 1. Outline of the crosses made between chloroplast mutant strains accumulating ζ-carotene and lycopene

Results and Discussion

In the first and second generations gained during the crossing of the ζ-carotene and lycopene heterozygotes the phenotype categories shown in Fig. 2 were produced.

From the Fig 2. it can be seen that the F_1 generation produced only normal endosperm thus showing that the ζ and *ly* factors are not allelic.

The ears gained from inbreeding represent four categories, the first of which contains exclusively normal grains, the second in addition to the normal has ζ-carotene grains, the third type has lycopene grains and finally the fourth has normal, ζ-carotene and lycopene grains too.

The genotypical distribution of the grains gained by successful crossing and having phenotypically normal carotenoid formation is shown in Table 1 based on progeny tests.

From the Table it can be seen that in the generations gained from both directions of crossing genotype categories show a distribution of 1 : 1 : 1 : 1.

When examining the relations of segregation in the ears containing ζ-carotene individuals, the χ^2 test produced a P value of 85% for a 3 : 1 proportion. The χ^2 probability value of the monofactorial segregation in the lycopenic strains is 15%.

Table 1

Distribution of the genotypes gained from the crossing of ζ-carotene and lycopene strains

Segregation: Genotype:	None $\frac{\zeta^+ ly^+}{\zeta^+ ly^+}$	Normal & lycopenic $\frac{\zeta^+ ly^+}{\zeta^+ ly}$	Normal & ζ-carotenic $\frac{\zeta^+ ly^+}{\zeta\ ly^+}$	Normal, lycopenic and ζ-carotenic $\frac{\zeta^+ ly}{\zeta\ ly^+}$	Total	Segregation 1:1:1:1	
						χ^2	P%*
$\frac{\zeta^+ly^+}{\zeta^+ly} \times \frac{\zeta^+ly^+}{\zeta ly^+}$	52	43	56	46	197	2.187	56
$\frac{\zeta^+ly^+}{\zeta ly^+} \times \frac{\zeta^+ly^+}{\zeta^+ly}$	32	28	33	23	116	2.135	56

N = 3

Table 2

Segregation of the generations gained from self-pollination of dihybrids originating from crosses of lycopene and ζ-carotene strains

$$\frac{\zeta^+ly^+}{\zeta^+ly} \text{ ♀} \times \frac{\zeta^+ly^+}{\zeta\ ly^+} \text{ ♂}$$

Number	Total no. of individuals	Normal	lycopenic	ζ-carotenic	Segregation 9:3:4	
					χ^2	P%
1	482	277	76	129	3.00	21
2	188	112	35	41	1.21	55
3	399	230	76	93	0.66	72
4	205	118	30	57	2.48	27
5	501	284	95	122	0.09	92
6	470	279	79	112	1.98	35
7	320	190	53	77	1.49	47
8	241	132	52	57	1.31	53
9	330	182	64	84	0.21	90
10	191	105	34	52	0.47	80
11	100	60	20	20	1.34	55
12	397	220	73	104	0.30	87
13	228	124	44	60	0.30	87
14	194	116	37	41	1.48	43
15	226	132	47	47	1.77	68
16	268	159	44	65	1.32	54
17	538	319	94	125	2.05	35
18	327	192	62	73	1.37	53

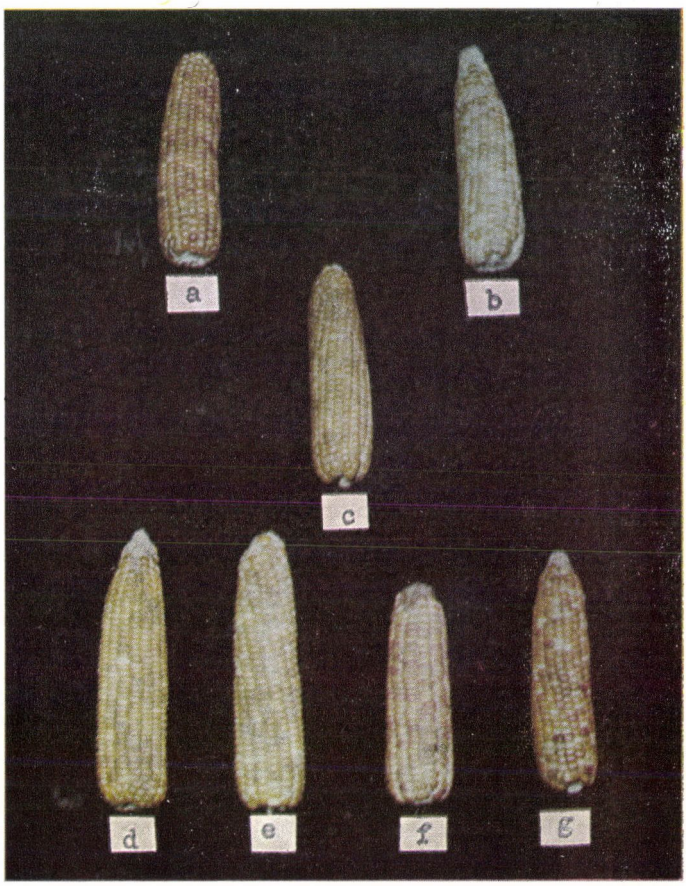

Fig. 2. Habitus picture of maize ears gained from the self-pollination, reciprocal crosses of heterozygotes for the accumulation of ζ-carotene and lycopene and gained as F_2 of these crosses

$a = \frac{\zeta^+ \, ly}{\zeta^+ \, ly^+}$, $b = \frac{\zeta \; ly^+}{\zeta^+ \, ly^+}$ ears gained from the self-pollination of individuals

c = ears gained from a × b
d, e, f, g = maize ears formed by the self-pollination of populations gained from the c grains

In the ears gained from the self-pollination of dihybrids the lack of the phenotype category corresponding to the homozygotic birecessive genotype can be attributed to the interaction of the two factors. This interaction can be deduced from the ratio of segregation. Since the polygenic dihybrid inheritance (9 : 6 : 1) and the dominant epistasis (12 : 3 : 1) can be very likely excluded from the interactions modifying the proportion of segregation, the recessive epistatic effect of the ζ-carotene factor was the most likely.

The ratios of segregation of the dihybrids can be seen in Tables 2 and 3.

From these Tables it can be seen that the relation between the ζ-carotene and lycopene factors can be well characterized by the recessive epistatic effect of the former. LINDSTRÖM (1925) and EYSTER (1950) reported on a similar inheritance when crossing the strains providing xantha and albino seedlings not identified with the carotenoid forming types.

Other carotenoid synthesis influencing genes (y_1 and y_3) have a complementary effect on one another (PERRY—SPRAGUE 1936). The y_1 and y_3 homozygotes have a low but qualitatively normal carotene content. Thus it can be

Table 3

Segregation of the generations gained from the self-pollination of dihybrids originating from crosses of ζ-carotene and lycopene strains

$$\frac{\zeta^+ \, ly^+}{\zeta \quad ly^+} \, ♀ \times \frac{\zeta^+ \, ly^+}{\zeta^+ \, ly} \, ♂$$

Number	Total no. of individuals	Normal	lycopenic	ζ-carotenic	Segregation 9 : 3 : 4	
					χ^2	P%
1	312	178	58	76	0.10	93
2	127	74	27	26	1.61	42
3	166	90	29	47	0.82	68
4	125	77	20	28	1.38	53
5	102	61	16	25	0.75	71
6	64	32	14	18	1.02	62
7	339	200	53	86	2.14	34
8	373	212	77	84	1.61	44
9	171	103	32	36	1.55	47
10	239	146	42	51	2.44	28
11	166	99	30	37	0.95	64
12	564	330	99	135	1.13	58
13	585	350	101	134	2.49	27
14	202	118	31	53	1.37	53
15	656	383	113	160	2.31	32
16	480	279	89	112	0.84	66

supposed that they control the formation of different in the chain of carotenoid synthesis and they do not directly have an effect on carotenoid biosynthesis. A similar situation is possible in the case of dimerism shown in relation to the inheritance of maize chloroplast pigments (DEMEREC 1935).

The ζ-carotene phenotype of the $\frac{\zeta ly}{\zeta ly}$

homozygote birecessive category well harmonizes with the general conceptions concerning carotenoid biosynthesis according to which ζ-carotene serves as a precursor for both β-carotene and lycopene (PORTER—LINCOLN 1950, CHICHESTER—NAKAYAMA 1963).

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THERMO-PHYSIOLOGICAL INVESTIGATIONS ON THE IMBIBITION AND GERMINATION OF SEEDS OF CERTAIN ARID ZONE PLANTS

I. THE SEEDS OF *MIMOSA HAMATA*

By

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Mimosa hamata Willd, is one of those typical arid zone species, which inhabit Rajasthan Desert. The plants flower in September and fruit in October to December; the seeds have therefore, to pass through terrible cold as well as heat. Attempts were made to furnish information regarding thermophysiological aspects as to how the seeds react and respond to the various temperatures, and how temperatures influence the imbibition and germination and regulate these processes.

Among the constant temperature range of 25° C to 55° C, 35° C, appeared to be the optimum temperature for germination of these seeds. They indicated 55 percent germination at this temperature. Low constant temperatures like 3° C and 10° C did not increase germination in any way.

Alternating temperatures or high temperatures pretreatment proved enhanced permeability as well as germination of these seeds. The seeds indicated 85 percent imbibition and 79 percent germination when placed with water at 100° C for the time interval of 30 minutes as against 5 and 4 percent imbibition and germination obtained in the control set. It was noticed that dry heat of 60° C, 70° C, 80° C was more helpful for increasing imbibition and germination when applied for a period of 24 hours; both imbibition and germination values were between 89 to 92 and 87 to 89 percent respectively. Dry heat of 90° C acted favourably when applied only for one hour's duration; 81 percent germination value was obtained in this case, which was maximum. The seeds when exposed to the dry heat of 100° C even for half an hour presented a very low germination percentage, viz., 15 percent. It was quite interesting to note that the seeds were affected quite adversely when exposed to dry heat of 100° C for 30 minutes, while this interval of time was found to be most beneficial when seeds with water were placed at 100° C.

An attempt has also been made to correlate the effects of these artificial conditions to those obtaining in the natural environment on the permeability of seed coats and germination of the seeds, and it was concluded that the hard seed coat was a sort of adaptation of the seed to its natural environment.

Introduction

Temperature is considered to be one of the most crucial factors in germination-regulating mechanism and a special agent in certain conditions for breaking the dormancy of seeds. It is more so in the case of such plants as inhabit, and are confronted by desert-like environments. Several workers like Harrington (1923); Morinaga (1926); Lehmann—Aichelf (1931); Toole—Toole (1939); Mayers (1942); Drake (1947) and many others have noted the effect of temperature in this respect. The work carried out so far on the germination of seeds of the plants of Rajasthan desert appears to be negligible. Such information relating to *Mimosa hamata*, which inhabits this desert, is totally

lacking in the literature available, though incidential references to the genus *Mimosa* are occasionally met with. Because of the lack of information, as has been indicated above, its prolific nature to establish itself and survive, and the reported medicinal potentialities of the seeds, it was felt worth-while to select the seeds of *Mimosa hamata* for investigations in order to study their germination behaviour and the factors which might possibly regulate it.

Mimosa hamata Willd. is a small shrub, typical of arid regions of India, and belonging the sub-family *Mimosoideae* of the *Leguminosae*. The seeds may also have some economic importance as it has been reported that they are pounded and boiled with buffalo milk and taken as a tonic (BLATTER—HALLBERG, 1918). The tree starts flowering in September (COOKE, 1958).

Material and Methods

The seeds of *Mimosa hamata* are set in the months of October to December. They might, however, be available at any other time as some of the pods happen to be always found attached to the plant even up to the next flowering season, and also because they are unapproachable by herbivorous animals, as the plants as well as the pods are furnished with large hooks or straight prickles.

The seeds are chestnut brown. They are sub-circular, slightly peaked towards the micropylar end. The seeds are 3 mm. to 5 mm. long, 3 mm. to 5 mm. broad, and 1.5 mm. to 2 mm. high; they are marked with a central depression, 2 mm. to 3.5 mm. $\times$ 1.5 mm. to 2 mm. on their flat surfaces.

The mature seeds used for the investigations reported in this paper were collected mostly in 1963. The seeds were separated from the pods, cleaned and stored in glass bottles.

The results incorporated herein happen to be only a part of series of studies on the germination of seeds that was spread over a period of several years.

Imbibition was initially studied by the increase in weight and volume of the seeds when placed in water, but later on, in subsequent experiments, imbibition was also perceptible to the naked eye as the increase in size, as a result of this process, was quite considerable and obvious. The seeds were soaked in distilled water in all the cases.

Germination experiments were carried out by the usual petri dish method. A wide range of temperature regimes was selected for the present work. The seeds were exposed to constant temperatures and alternating temperatures, as also to the room temperature. Any change of temperature was secured by transferring the petri dishes containing the seeds from the room temperature to the incubator or to the refrigerator as was needed and vice versa.

Seeds were subjected to exposure to various high temperatures to determine the effect of dry heat or hot water treatment. For dry heat, dry seeds were kept as such in an incubator for different intervals of time (30 minutes to 24 hours), while for hot water treatment, seeds in beakers containing water were kept in an incubator manipulated to 100° C for different intervals of time (5 minutes to 24 hours).

Heat treatment, for shorter periods, was effected by placing the seeds in boiling hot water which was allowed to cool down gradually with the seeds remaining in it. The seeds were kept in it for the next 24 hours.

For prechilling, seeds were placed as such at 2° C for definite specified periods, while for low temperature pretreatment, seeds were placed on the moist filter papers in petri dishes, and exposed to 3° C and 10° C for different intervals of time. Prechilled seeds were also, in certain cases, subjected to hot water pretreatment.

By conducting a few preliminary experiments the time taken for maximum imbibition and germination was determined. Therefore, the time allowed for germination was sufficient to permit maximum germination attainable under a particular experimental set-up. Other details have been indicated at appropriate place.

Results and Discussion

It became quite evident in the initial experiments that it was the impermeability of seed coat to water which was directly associated with failure of termination. Hence it was felt worthwhile to direct attention towards imbibition as well; equal importance was attached to imbibition and germination.

When fresh seeds were placed in water, very poor percentages of imbibition, viz., 5 to 15 percent, were observed even after prolonged soaking of about a month in average laboratory conditions of light and temperature.

Several attempts were made, therefore, to enhance the permeability of testa and thus bring about an increase in the subsequent process of germination. This was done by exposing the seeds to various temperature ranges as has been indicated above for different periods of time.

Chilling pretreatment

Chilling pretreatment had been given to the seeds for 15, 30, 45, 60, 75 and 90 days after collection. They were then chosen for imbibition and germination experiments in order to study the effect of chilling pretreatment on these processes.

Hot water pretreatment

Hot water pretreatment had also been given to the seeds stored for same specified periods, viz., 15 to 90 days. Pretreated seeds were then used for imbibition and germination experiments.

Combined effect of chilling and hot water pretreatments

The combined effect of chilling and hot water pretreatments was studied by first prechilling the seeds for various specified periods; then hot water treatment was applied to such prechilled seeds. They were then selected for studying their imbibition and germination capabilities.

The data pertaining to all these pretreatments, (chilling, hot water, and chilling followed by hot water) together with control set, run simultaneously, have been presented in Table 1.

Effect of constant temperature

For maintaining seeds at low temperatures, viz., 3° C and 10° C, they were placed in a refrigerator. But there was no germination either at 3° C or at 10° C; however, 14 percent imbibition was observed at the latter temperature (results are not included in any Table of Figure).

Table 1

Effect of hot water, chilling and combined effect of chilling and hot water pretreatments on imbibition and germination of seeds of Mimosa hamata

Pretreatments	Percentage of imbibition and germination					
	Time of pretreatment					
	15 days	30 days	45 days	60 days	75 days	90 days
*Control						
Imbibition	15	15	13	21	13	0
Germination	12	12	13	13	0	0
Chilling pretreatment						
Imbibition	8	71	32	20	13	0
Germination	0	5	17	16	0	0
*Hot water pretreatment						
Imbibition	30	30	23	24	20	17
Germination	8	10	15	20	17	17
Chilling and hot water pretreatment						
Imbibition	20	16	24	8	27	10
Germination	12	8	4	4	13	0

* For the control set and hot water pretreatment seeds were stored at room temperature for same intervals of time.

Table 2

Effect of temperature along with time factor, as indicated by the number of days, on imbibition and germination of the seeds of Mimosa hamata

Temperature in which seeds were kept	Imbibition percentage							Absolute germination percentage							Correlative germination percentage						
	Time in days							Time in days							Time in days						
	1	2	3	4	5	10	15	1	2	3	4	5	10	15	1	2	3	4	5	10	15
25 °C	11	14	19	25	26	38	43	7	14	19	25	26	32	34	64	100	100	100	100	84	79
30 °C	10	11	13	20	21	31	42	8	8	9	12	15	24	35	80	73	69	60	71	77	83
35 °C	8	13	21	26	27	42	56	8	13	21	25	26	42	55	100	100	100	96	96	100	98
40 °C	8	13	16	21	23	42	57	0	0	7	8	12	27	39	0	0	44	38	52	64	68
45 °C	10	11	15	20	25	47	60	2	2	2	5	5	5	5	20	18	13	25	20	11	8
50 °C	2	9	12	19	25	38	61	0	0	0	0	0	0	0	0	0	0	0	0	0	0
55 °C	67	72	76	83	84	90	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The results presented in Table 2 indicate the effects of constant temperatures in the range of 25° C to 55° C on imbibition and germination of seeds. The seeds had been placed in an incubator adjusted to a particular temperature for a period of fifteen days except for the time when the petri dishes were taken out for the observations. The effect of temperatures above 55° C have been dealt with while considering the effect of dry heat on these seeds.

Among the temperature range of 25° C to 55° C, 35° C seems to be the optimum temperature for germination of these seeds; they indicated 55 per cent germination at this temperature.

It was noteworthy that whereas the higher temperatures of 50° C to 55° C in the temperature range of 25° C to 55° C could indicate the maximum imbibition values, no germination could be observed at these higher temperatures in the case of these seeds.

From the germination values obtained after an exposure to various temperatures for a period of fifteen days, it was apparent that there was a peak with regard to germination vis-à-vis the rise in temperature; there was a gradual rise to the peak and thereafter, a fall from the maximum rise. This phenomenon of a gradual rise to a maximum point or peak and gradual fall thereafter has been clearly brought about in Fig. 1.

A very remarkable observation was an extraordinary rise in the imbibition percentage on the first day when the seeds were exposed to temperatures between 50° C and 55° C. At 50° C only two per cent imbibition was indicated whereas at 55° C, 62 per cent imbibition was attained on the very first day. It indicated a comparative effectiveness of the temperature of 55° C to bring about imbibition on the very first day. The difference in the two values of imbibition became markedly narrower towards the end of the total period of observational time, i.e., 15 days when 61 per cent imbibition was indicated at 50° C and 90 per cent imbibition at 55° C.

High temperature pretreatment

The effect of high temperature pretreatment was studied in two ways. In one case, the seeds with water were placed in an incubator at a constant temperature of 100° C for different intervals of time, viz., 5, 10, 15, 20, 25, 30 minutes, and 1, 2, 3 and 24 hours, and they were then transferred to the room temperature for imbibition and germination. In the other case, seeds as such, were placed at constant temperatures ranging from 60° C to 100° C for various intervals of time, and they were then transferred to the room temperature for imbibition and germination. In the former case, it amounted a sort of hot water pretreatment for definite specified periods, while in the latter case the effect of dry heat pretreatment given to the seeds was observed.

From the data reported by CHATTERJI—KAMAL MOHNOT (1964), and also from the knowledge gained by analysing the results of some other experiments conducted by the authors with certain other seeds, it was so felt that hot water pretreatment was an effective tool in enhancing the imbibition values and bringing about germination of most of the seeds experimented with. It was also noted that if, in a particular case, especially of fresh seeds, hot

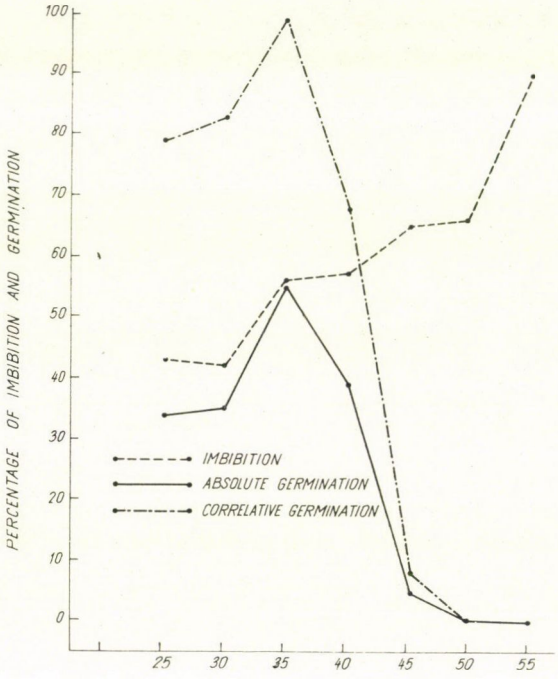

Fig. 1. Effect of Constant Temperature on Imbibition and Germination of Seeds of *Mimosa hamata*

water pretreatment, once applied, was not sufficient to bring about an increase in imbibition, repeated exposures to such pretreatment was definitely proved to be beneficial in promoting both imbibition and germination to at least some considerable extent. In some seeds, e.g., *Cassia auriculata*, sometimes hot water pretreatment was found to be effective, only when the seeds were prechilled. It was, therefore, thought that alternate exposure of the seeds to 100° C and then transferring them to room temperature was more feasible to bring about imbibition and germination of the seeds of *Mimosa hamata* as well. The data plotted in Fig. 2 would clearly demonstrate that an increase in the length of the time period of the pretreatment raised the imbibition percentage

Though the maximum imbibition values, viz., 100 per cent, were indicated when the seeds were exposed to pretreatment for longer intervals of time, viz., 3 and 24 hours, the maximum germination values were, however, obtained with seeds exposed to pretreatment for shorter intervals of time. The pretreatment applied to the seeds for 30 minutes indicated a maximum germination value of 79 per cent and an imbibition value of 85 per cent. Though imbi-

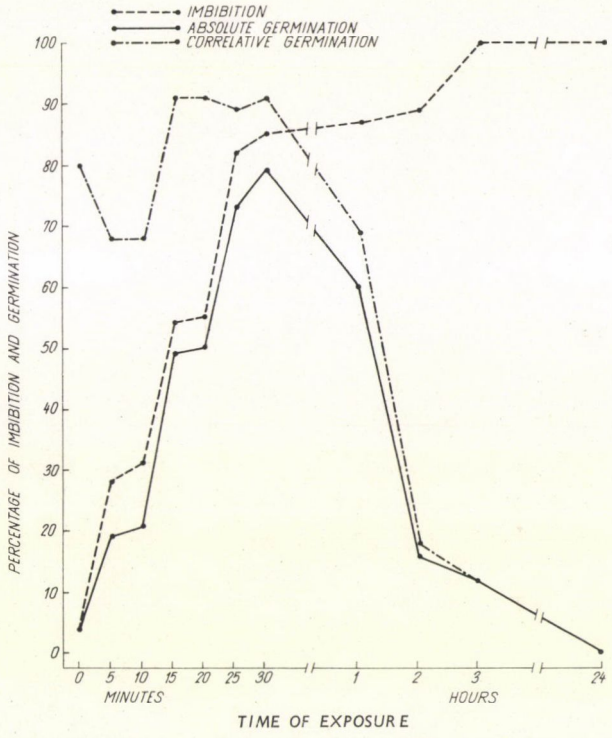

Fig. 2. Percentage of Imbibition and Germination of *Mimosa hamata* Seeds Subjected to the Pretreatment of Temperature of 100° C for Different Durations

bition improved when seeds were subjected to pretreatment beyond 30 minutes, the germination values dropped indicating that the longer duration of pretreatment affected germinability adversely.

Effect of dry heat

The data pertaining to the imbibition and germination values after pretreatment of the seeds with dry heat have been presented in Table 3. It was observed that imbibition exhibited as high a value as 90 to 100 per cent. The highest values of germination recorded were 89 per cent at 80° C when pre-

Table 3

Effect of high temperature pretreatment and exposure to dry heat for varying intervals of time on imbibition and germination of the seeds of Mimosa hamata

Temperature	Imbibition percentage					Absolute germination percentage					Correlative germination percentage				
	Exposure time in hours					Exposure time in hours					Exposure time in hours				
	0.5	1	2	3	24	0.5	1	2	3	24	0.5	1	2	3	24
60° C	48	73	87	71	89	48	73	87	71	89	100	100	100	100	100
70° C	71	67	75	85	91	71	63	74	81	87	100	94	98	94	95
80° C	90	93	79	92	92	70	78	79	89	88	77	84	100	97	96
90° C	83	89	92	90	100	72	81	76	65	12	87	91	80	72	12
100° C	95	92	94	100	97	15	3	7	0	0	16	3	7	0	0

treated for three hours, indicating that most of the imbibed seeds could germinate. Hence it might be safely concluded that dryheat immensely increased the permeability of seed coats to water and did not in any way impair the viability of the seeds or injure their embryo when subjected to a temperature as high as 80° C for three hours' duration. Even the temperature of 90° C did not adversely influence the germination to a very appreciable extent.

This would suggest that the seeds could withstand and tolerate high temperature without hindering the process of germination. Recently this fact was also corrobarated by SEN—CHATTERJI (1965), while working with *Calotropis* seeds.

A thorough analysis of the data also revealed a striking and significant fact that a probable relationship seemed to exist between time and temperature as suggested by RINCKER (1954). It was observed to be somewhat inverse in relationship. The lower the temperature, the longer would be the time required to attain maximum response but it did not mean definitely that this inverse relationship would hold good strictly in all the cases and at all the places to a similar extent and should always form a straight line in graphical illustrations.

The results appear to correspond with what prevails in nature. As the seeds set in October — December, they have to face the varying hazards of nature, terrible climatic fluctuations and variations of diurnal as well as seasonal temperatures, such as extremes of cold winter and hot summer, before they could be expected to germinate during the following rainy season.

Low temperature pretreatment and even chilling to some extent might be considered as corresponding to the cold prevailing in January, the coldest month of winter in this part of the country, while constant high temperatures and dry heat pretreatment, as corresponding to the heat prevailing during the months beginning from April and extending up to June. The treatment of

chilling followed by hot water pretreatment, or alternation of low and high temperatures, corresponds to the fluctuations in temperatures, both diurnal and seasonal, in the natural habitat of the plant. These various pretreatments were designed especially in order to investigate the effect of artificial condition corresponding to those obtaining in the natural environment on the permeability, and consequently, on the germinability of seeds. The results obtained and discussed above would tend to indicate that the presence of a hard and impermeable seed coat enhances the adaptibility of the seeds to its normal environs. The alternating fluctuations of low and high temperatures, both diurnal and seasonal, as also the availability of water just after the hottest months in the form of rain brings about imbibition and germination of the seeds in nature just as these variable factors brought about similar results in the laboratory.

Acknowledgement

We are indebted to Dr. D. N. Sen, Lecturer, Botany Department, University of Jodhpur, for the keen interest evinced by him during this study and for his helpful criticism.

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DATA ON THE TRANSLOCATION AMINO ACIDS OF WHEAT, MAIZE AND RICE, ON THE ROLE OF ORNITHINE

By

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The composition and quantity of the amino acids in the bleeding sap of wheat, maize and rice have been studied at the phase of flowering. It has been established that of the translocated amino acids in the root pressure sap glutamine, asparagine, ornithine and serine are found in great quantity while in the case of rice — besides the above — there is also alanine.

The characteristic amino acid of the bleeding sap is ornithine which could not be detected in other plant organs except in the root. It is supposed that ornithine might be a specific constituent of the enzime protein regulating material transport from root into shoot.

Among the plants examined the concentration of the amino acids was highest in maize and it was lowest with rice. At the same time the most amino acids could be detected in the sap of rice.

Introduction

From the amino acid composition of plants and their organs respectively, we might draw conclusions as to the N supply if their dry material and total N content are also taken into consideration, PÁLFI (1964). We have already established that different nutrient supply causes but seldom qualitative change in the amino acid spectrum of cereals, PÁLFI (1963, 1964). The same has been stated by SHIMODA (1960) in the course of his experiment with rice. The slighter differences that might occur, can be followed only with isotope technique or by way of the specific reactions of the amino acids.

As a response to raising the dose of N, the quantity of every amino acid generally increases, so the change of quantity of the total amino acid is a very sensitive physiological index, PÁLFI (1964). This is also proved by the 100—300% difference in the total amino acid content evoked by various N supplies at the different leaf-levels, PÁLFI (1964).

The amino acid data of the bleeding sap are important because they refer to the supply synthesized by the root at the time of examination.

In our present experiment we aimed at studying the main amino acids of the bleeding sap in cereals. In our opinion the amino acid spectrum might be such a physiological index that indicates the rate of supply in plants.

Results referring to maize are contradictory. POTAPOV—CSEH (1956) have proved arginine being the main component of root pressure sap, while

according to BEKMUHAMEDOVA (1961) this was alanine. This problem, too, has been investigated by us. Examining the amino acids of the root pressure sap in rice, ZSOLDOS (1960) established that alanine was the main component.

Materials and Method

For our investigations we have used "*Bezostaya 1*" wheat variety grown in the clay soil of the Szeged region, "*Szeged Yellow Dent Corn*" maize, — and "*Dubovskij 129*" rice varieties. With all the three plants root pressure sap was gathered at the flowering phase on two occasions with each plant. The sterile sap of the three plant varieties was examined by one- and two-dimensional ascending chromatography. On Schleicher-Schül Nr. 2043b paper butanol-glacial acetic acid-water (2 : 1 : 1) and phenol-water (4 : 1) were used as solvents while for developing isatine and ninhydrine were used. Fixation was performed with copper and nickel salt solution. The methods of "Universal standard mixture" and "Quick determination of the total amino acid with elution" were also applied (1964). When determining the total amino acid with the unknown extracts a series of standard mixture of increasing concentration was developed with ninhydrine on a paper in repetition. After eluting the spots fixed with copper-salt solution, photometry was performed. The extinction values of the eluted standard spots produce the calibration curve. After the sap had been distilled dry at 65° C, it was hydrolized with 6n hydrochloric acid for 24 hours at 105° C sealed in glass.

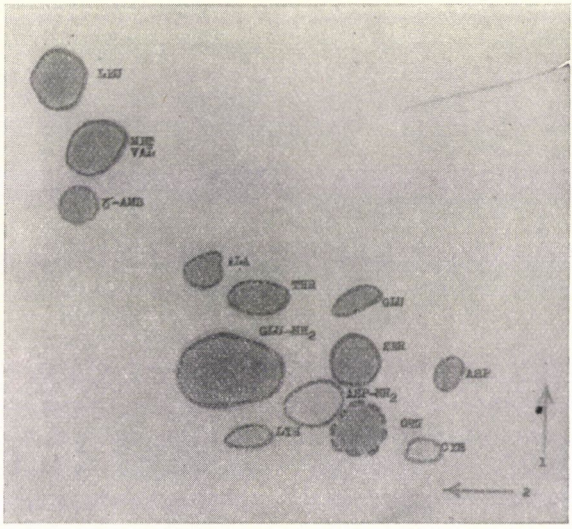
Experimental Results and Discussion

Spots on the amino acid chromatograms of the root pressure sap (Figs. 1—3) prove that in the sap of cereals 11—15 amino acids can be found. Amino acids in greatest number were produced by rice (Fig. 3) while the greatest amino acid concentration appeared in maize (Table 1). Glutamine, asparagine, ornithine and serine prevail with all the three kinds of plants though with rice there is also alanine. At the same time in the shoots, leaves and roots of

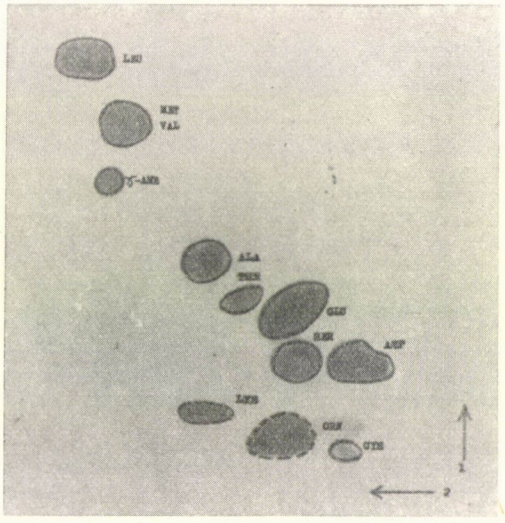
Table 1

The amount of wheat, maize and rice sap collected during 6 hours, number of amino acids, concentration of total amino acids and amino acid content in each single shoot at the time of flowering

Plants	Amount of Sap ml (1 shoot) 6 hours	Number of amino acids	Concentration of total amino acids mg/ml	Total amino acid content of sap collected during 6 hours, in mg.
Wheat (average of 100 shoots)	0.15	14	1.05	0.16
	± 0.013		±0.046	± 0.012
Maize (average of 30 shoots)	38.60	11	1.44	55.58
	± 4.07		±0.11	± 8.60
Rice (average of 100 shoots).....	0.54	15	0.48	0.26
	± 0.043		±0.023	± 0.018



(a)

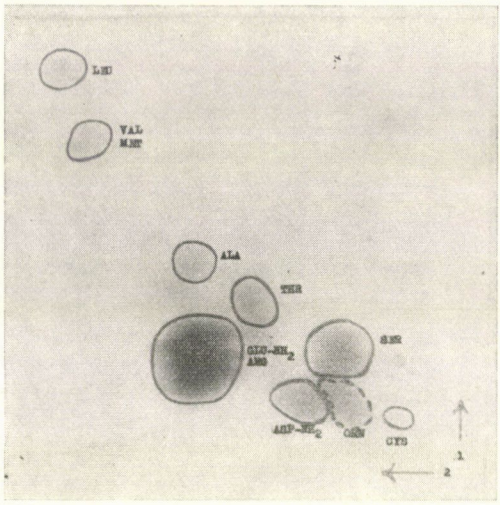


(b)

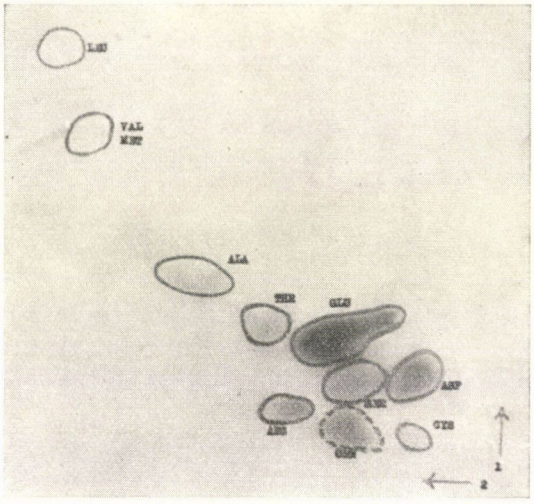
Fig. 1. Amino acids of the native (a) and hydrolized (b) bleeding sap in wheat

rice glutamine and asparagine do not prevail, — sometimes they can hardly be detected at all, PÁLFI (1963).

It is conspicuous that ornithine is found with each sample in a relatively high quantity. On the chromatograms obtained after hydrolysis, as the amides disappear, the corresponding amino acids increase. Ornithine, however, remains unchanged even after hydrolysis. Simultaneously from among the



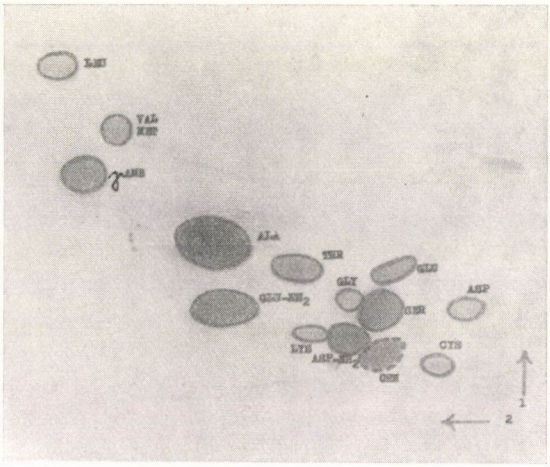
(a)



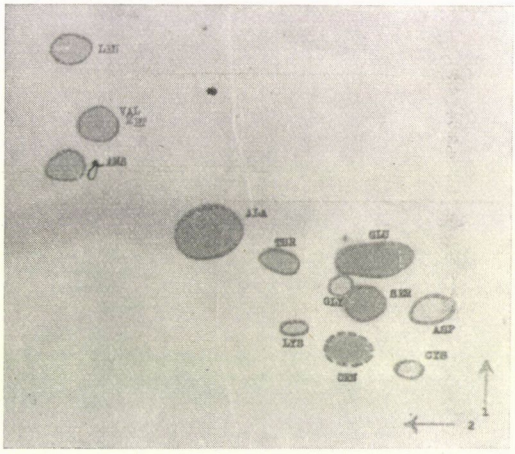
(b)

Fig. 2. The amino acids of the native (a) and hydrolized (b) bleeding sap in maize

organs of the three plants examined it was only the root in which we succeeded in detecting ornithine. Since in the bleeding sap arginine and citrulline have not been found in considerable quantity, it might be supposed that in the root no urea cycle occurs, may be ornithine does not take part in this cycle. We may also conclude that ornithine is the precursor of the regulating material streaming from roots into shoots.



(a)



(b)

Fig. 3. The amino acids of the native (a) and hydrolized (b) bleeding sap in rice

Ornithine has already been found in materials of considerable physiological effect like tyrocidine, gramicidine and bacitracin, by GORDON *et al.* (1943), NEWTON *et al.* (1953) and SANGER (1946).

FARKAS *et al.* (1963—1964) have established that generally in detached leaves the activity of most enzymes increases quickly. It can be supposed that after cutting the shoot off, there occurs a similar reaction also in the root. When isolating the root, not only the activity of the enzymes might increase but also the quantity and the translocation of the constituents of the enzymes, the amino acids.

The data of RATNER *et al.* (1963) prove that of the 16 amino acids and amides besides glutamine and asparagine, it was ornithine that had the greatest effect on the growth and protein synthesis of the isolated alfalfa root. This fact shows that ornithine with its two amino groups might also act as a N transport compound. Anyway, besides the urea cycle the role of ornithine is hardly known. Of course, we have also to mention the genetic connection of ornithine with glutamic acid and proline, FINCHMAN (1951), RACUSEN *et al.* (1954). VAN ETTEN *et al.* (1963) have studied the amino acid spectrum of 200 monocotyledonous and dicotyledonous plant species belonging to 56 families. However, they do not mention either the occurrence or the role of ornithine.

BREYHAN *et al.* (1962) when making experiments with potato have found to be the most essential, in the course of nutrient mobilization, the differences in the quantities of the complex serine, glutamine, asparagine (SGA). Our present experimental data support their result, however, the important role of ornithine is also stressed.

The rich amino acid spectrum in the bleeding sap of rice can be explained by the fact that in irrigated soil N is reduced being present in its ammonium-ion form, PÁLFI (1959). Ammonium is immediately built in organic form by the root system (KRETOVICH *et al.* 1960) if carbohydrates or the components of the Krebs cycle are present. At the same time in aerobic soils the nitrate-nitrogen prevails which has, before assimilation, to be reduced by cereals.

In many cases the bulk of nitrates streams up unchanged from the root to the shoots with the bleeding sap, PÁLFI (1959, 1960).

In case of irrigated rice it can be considered advantageous that no water insufficiency occurs unless the salt content of the rhizosphere is high e.g. with saliferous soils when symptoms of drought can be observed (leaf-tip wilt). The leaves of cereals die gradually off in the course of fruit ripening except those of the riceplant on which the upper leaves are vivid green even at the time of full maturing.

Our results prove the arganine or alanine not to be prevailing in the bleeding sap of maize (Fig. 2) as shown by the investigations of POTAPOV—CSEH (1956) and BEKMUHAMEDOVA (1961), but glutamine is. The ornithine content of the root pressure sap of all three plants is equally rich thus we might suppose this compound to be generally important with these plants.

Conclusions

In our present investigation we have established that the proportion between the translocation amino acids in wheat, maize and rice differs from the amino acid content of the separate organs.

The determinations of total amino acids have shown that the amino acid concentration of the root pressure sap in maize is the highest, that of wheat is somewhat less, while the lowest amino acid concentration has been found in rice. At the same time, the greatest number of amino acids could be found in the sap of rice. This is explained by the fact that the ammonium ion in the anaerobic soil of irrigated paddy-fields can be used more easily for amino acid synthesis than the nitrate of aerobic soils.

In the root pressure sap glutamine, asparagine, ornithine and serine prevail while in rice there is, in addition, also alanine.

The characteristic amino acid of bleeding sap is ornithine that can be detected after hydrolysis, too. Among the organs of plants observed, it was only the root that contained ornithine in smaller quantity; the stem, leaf, ear and panicle, respectively, didnot. This fact proves ornithine to be presumably a specific constituent of the enzyme protein regulating material transported from the root into the shoot.

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PANICLE DEVELOPMENT IN RICE

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An investigation has been carried out in two Indian rice varieties *(Dular* and *C.B.I.)* to prepare a detailed scale of panicle development in rice. Attempt has also been made to correlate these stages with the size of growing apex and other morphological features. The whole development has been classified into 24 stages. This classification is based on microscopical examination of the exposed shoot apex and determination of clearly recognizable changes in morphological features. The increase in size of the growing apex and the panicle appears to follow certain definite developmental stages.

Introduction

Studies on developmental physiology and breeding works requiring a knowledge of the developmental pattern of a new variety necessitate a systematic study of inflorescence development in cereals, which begins with germination as an undifferentiated growing point, follows a gradual development and ends with heading as a fully emerged inflorescence bearing the spikelets.

Histological methods of determination of inflorescence development, as done by AKIMOTO—TOGARY (1939) and MATSUSHIMA *et al* (1954) for some of the later stages of development of rice panicle for example, would be very much cumbersome, lengthy and time consuming. Hence, they should be replaced with a more easy and rapid method. Morphological study is more rapid and less laborious, and at the same time enables examination of all the components that would be necessary for the evaluation of developmental patterns.

Such morphological studies to fix the stages of development of growing point and the inflorescence have been done on some cereals and grasses by some workers, since the pioneering works of BONNET (1935, 1936), PURVIS—GREGORY (1937) and GREGORY—PURVIS (1938). As a result of these and other investigations, some scales of development have been proposed in some crops. BANERJEE—WIENHUES (1965) recently proposed a 17-stage scale based on morphological differentiation for three cereals, wheat, barley and rye.

Based on their experience with Japanese rices, MATSUSHIMA *et al.* (1954) tried to predict the developmental stages of the reproductive organs through such indices as "foliar age", "days to heading", and "ear length".

In India, no such morphological study on panicle development was previously made on rice. However, with the studies on duration and the influence

of photoperiod and other factors on this character gaining more in importance, it is becoming increasingly necessary to prepare a scale of development of rice panicle, based on differentiation and development of the morphological parts. In order to be able to serve as a type of reliable phytometric index, this scale should be applicable to such investigations as mentioned above under different conditions in India.

Hence, a preliminary study was taken up in this laboratory with a view to preparing a scale of development of rice panicle under Indian condition. An attempt was also made to correlate such morphological stages with the size of the growing apex. The following is a report of this work.

Material and Method

Seedlings of the following pureline varieties, germinated previously in petri dishes, were planted in 10″ pots on August 16, 1965:

(1) *Dular* — A short duration, awnless autumn rice *(Aus)*.

(2) *C.B.I.* — A short duration (but somewhat later than *Dular*), awned spring rice *(Boro)*.

Subsequently, a few more sowings were also done to have a continuous supply of different stages at each time throughout the observation period. These different sowings also gave an idea of the influence of different seasonal conditions on the developmental stages. The usual cultural methods were followed for keeping the plants healthy.

A number of plants were collected from each variety at short intervals. The growing point was prepared for microscopical examination by removing the leaves, at first without and later with the aid of stereoscopic binocular microscope (maximum magnification × 80). The stages of morphological development were also determined under the same microscope. Occasionally, the prepared growing points were preserved in weak F.A.A., in cool temperature (10°—20° C). This did not vitiate proper detection of the stages, although BANERJEE—WIENHUES (1965) were not in favour of such chemical preservation. For ascertaining the P.M.C., reduction division and pollen stages, Acetocarmine (2%) smearing and examination under standard binocular microscope was resorted too. The final stages from beginning of panicle emergence to heading were determined macroscopically on the growing plant itself.

Length and breadth of growing point had been, measured in centimeter from one leaf primordial stage till complete differentiation of anther and style. Besides, length of panicle, awn, spikelets, anther and style had also been measured (in cm.) since the beginning of their initiation until heading. The measurement of beginning stages were made with the help of ocular micrometer and the later stages with the help of centimeter scale or millimeter graph papers. All measurements have, however, been expressed in centimeter.

Description of Stages and Discussion

The various stages of panicle development in rice have been described in Table I. Due to the fact that the differences in regard to the dimensions of the growing point or panicle or other morphological parts between the two varieties studied were not consistently and contrastingly clear, only mean of the measurements of both the varieties pooled together have been presented in the table against each morphological stage of development.

Development of the growing point, seated just above the main culm base, begins with one leaf primordial stage. At this stage, growing apex of the main culm is hardly above ground level. The internodes are very condensed

and too inconspicuous at this stage. The rice plant remains for a considerable time in the vegetative phase at this stage. The late variety *C.B.I.* remains for a longer period in this stage than the early variety *Dular*. The other activities at this stage are growth of young tillers and emergence of a few leaves from the earlier embryonically determined primordia. It is significant to record here the observation that tillers developing from the culm base after the growing point of main culm has passed from this stage to the next morphological stage remain mostly ineffective.

The first internode then begins to elongate and simultaneously the growing point passes into the two leaf primordial stage. The stem which was earlier more or less flat begins assuming a comparatively round shape at this stage. With the roundness of stem becoming more and more perfect, follow the subsequent stages. The two leaf primordial stage is of short duration and gives way very quickly to panicle initiation. As a result, it becomes often difficult to detect this stage under the microscope.

Next, the growing point gives out the primary branch of the panicle. Up to this stage, the main axis of the growing point is quite distinct.

The panicle branching becomes progressively clear with the differentiation of leaf primordia in each branch. The main axis can be differentiated from the other branches at this stage due solely to its possessing more leaf primordia. This main axis subsequently forms the rachis proper with differentiation of the terminal spikelet at a considerably later stage, whereas the primary branches constitute the rachilla. From this stage onwards constriction starts developing at the base of the panicle.

Then follows the initiation of secondary branching accompanied by bracteal hairs on primary branches in basipetal succession. The development of other organs begins in the mid apical region of these branches and proceeds upwards and downwards.

The whole growing apex becomes gradually covered with the last leaf-sheath, this phenomenon beginning with the initiation of the primary branches.

After the secondary branching stage, the spikelet initiation (tertiary branching) stage begins. This process begins with the differentiation of 4 leaf primordia in successive order on tertiary branch. These primordia occupy alternate positions. The first two basal primordia give rise to two non-flowering glumes and the later two to flowering glumes (*Lemma* and *Palea*). The distance between lemma and palea is considerably shorter than that between the outer glumes. Above the glume initials reappears simultaneously a round shaped flower primordium.

The initiation of secondary branching commences with a sudden and remarkable increase in the length and breadth of growing point. In subsequent stages, this accelerated pace of increase in growing point dimensions is clearly discernible.

With the development of spikelet components there is another sudden increase in the dimensions of growing point, which is particularly noticeable in the breadth measurement.

The stamen development begins with the appearance of its initials in two or three spikelets just below the panicle apex. The outer glumes are, by this time, almost fully developed and awns appear on a few lemma. The panicle length registers another remarkable increase at this stage.

Soon, all the six stamen-initials with a distinct region in the middle (gynaecium initial) and two small primordia (lodicules) below the stamen initials become visible under the microscope in the lap of the developing lemma and palea.

In the next stage, the panicles become somewhat compact with all the rachilla pointing upwards. As a result, the developing panicle appears to have become slightly reduced in breadth (stage '14' in Table 1). At this stage, the development of awn, lemma and palea continues further.

Next, the styles begin bifurcating to give rise to two stigmas. The lemma and palea are at this stage almost completely developed and cover the floral parts. With the completion of development of anthers and style (stage '16'), the awn length shows a sudden increase. This is followed by the development of stigmatic hair with increased panicle length and spikelet size.

The P.M.C. stage is preceded by the completion of development of feathery stigma, the attainment of full spikelet size and with the ovary having become quite prominent. The panicle begins elongating rapidly from this stage onwards till heading.

The heading in rice, like in many other cereals and grasses, can also be divided into 3 stages: beginning of panicle emergence, panicle almost half emerged out of the flagleaf sheath, and full emergence.

Another particular feature observed, while following the progress in panicle development, is the emergence and disappearing of bracteal hairs. They become visible under the microscope with the beginning of primary branching, subsequently increase in number and still later become so profuse that they mask the whole young panicle almost completely, rendering examination of components of the latter under microscope very difficult unless they are first carefully removed. These hairs develop from the bases of the branches and the spikelets. Their number begins to decrease when spikelet has properly organized itself and their presence becomes inconspicuous just before blooming so much so that only one or two hairs accompany the panicle up to the ripening stage.

The development of the rice panicle has, thus, been divided into 24 morphologically distinguishable stages. This differs from the 21-stage scale of MATSUSHIMA *et al* (1954). The different dimensions do not tally with those given by them. Either this is perhaps due to differences in the environmental conditions under which the two investigations have been carried out. Further

Table 1

Developmental stages of rice panicle

Stage	Description	Measurement (in cm)	Remarks
1.	One leaf primordial stage.	.0063L × .0069B	
2.	Two leaf primordial stage.	.0113L × .01B	
3.	Initiation of panicle branching.	.015L × .0125B	
4.	Branching of panicle is clearly visible: the most developed branch (main axis) will give rise to rachis proper (3—4 branches have developed and each branch is provided with a leaf primordium).	.0175L × .0188B	
5.	Initiation of secondary branching and simultaneous appearance of bracteal hairs.	.025L × .02B	
6.	Secondary branching with one leaf primordium under each growing apex. Initiation of hairs from the axis of each branch is evident. The apex of each branch is like a round headed cylinder. A well defined constriction appears at the base of panicle. (This brings in the exposed growing point resistance to desiccation more than in the previous stages.)	.0375L × .0275B	
7.	Initiation of tertiary branch, which will be transformed later into spikelets. There are no leaf primordia below the apex of this new branch. The position from which this has developed is recognizable from two alternate rings of depression and swelling.	05L × .05B	
8.	Profuse growth of bracteal hairs and development of leaf primordia below each growing apex (tertiary).	.0575L × .05B	
9.	Tertiary branch is more protruding, prominent and possesses 3 leaf primordia.	.075L × .0575B	
10.	Four leaf primordial stage of each tertiary growing apex. Henceforth, conversion of this branch into spikelets is quite clear.	.100L × .0625B	
11.	Spikelet development is quite distinct. The lower two primordia develop into non-flowering glumes and the upper two into lemma and palea. Development proceeds from the mid apical region in both directions (upwards and downwards) along the vertical axis.	.125L × .08B	
12.	Palea development is quite distinct.	.1375L × .0875B	
13.	Initiation of stamen development in 2—3 spikelets just below the panicle apex. Glumes become more developed with sudden tapering of their apical portion and the ends assuming roundness. Beginning of awn development.	.2L × .0875B	
14.	Awn development is quite prominent: lemma and palea have not yet fully covered the flowering portion, rather have formed a 45° angle, as a result of which stamens are still visible.	.25L × .075B	

Table I cont.

Stage	Description	Measurement (in cm)	Remarks
15.	Lemma and palea have completely closed to form a chamber inside. Bifurcated style initiation. Anther development is not yet complete.	Pl. — .45L × .075B Awn — .025 Spikelets — .075L × .0375B	Awn development only in *C.B.I.*
16.	Development of stamens and style is complete.	P. — .9L × .1B Awn — .125 Spikelets — .0875L × .0375B	Awn development only in *C.B.I.*
17.	Initiation of stigmatic hairs. Ovary is white and prominent.	Pl. —1.1L Awn — .125 Spikelets — .1L × 0.4B Anther — .05 Style — .0625	Awn development only in *C.B.I.*
18.	Feathery stigma is fully developed. Ovary is slightly green in colour.	Pl. —1.5L Awn — .15 Spikelets — .3L × .045 Anther — .1L	Awn development only in *C.B.I.*
19.	P.M.C., stage	Pl. — 2.0L Awn — .25L Spikelets — .4L × .07B	Awn development only in *C.B.I.*
20.	Reduction division stage.	Pl. — 5.0L Awn — .3 Spikelets — .5L × .08B Anther — .2L	Awn development only in *C.B.I.*
21.	Pollen grain stage.	Pl. — 12.01 Awn — .3 Spikelets — .6L × .12B Anther — .275L	Awn development only in *C.B.I.*
22.	Beginning of panicle emergence.	Pl. — 13.0L Awn — .4 Spikelets — .6L × .15B Anther — .3L	Awn development only in *C.B.I.*
23.	Emergence of half the panicle length.	Pl. — 13.5L Awn — .5 Spikelets — .6L × .15B Anther — .3L	Awn development only in *C. B.I.*
24.	Fully emerged panicle (heading).	Pl. — 18.0L Awn — .9 Spikelets — .6L × .15B Anther — .3L	Awn development only in *C.B.I.*

N.B. Pl. = Panicle length.
L. = Length.
B. = Breadth.

work under still different environmental conditions and with more varieties will be necessary to make this scale of panicle development uniformly applicable under all conditions of experiment.

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A STUDY OF FERTILIZATION AFTER REMOVING DIFFERENT AMOUNTS OF VARIOUS PARTS OF THE PISTIL

By

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We have removed various amounts of the different parts of the pistil of the *Solanum melongena* L. as well as the stigma, half of the style, the entire style and then the pollen was placed on the cut surfaces. Depending on variety, fruit setting occurs on the damaged pistil and viable seeds are formed in the fruit. The removal of the style, i.e., the removal of substances prohibiting the development of tubes and growth, increases the degree of crossability in case of the varieties which are difficult to cross because the degree of fruit setting — in comparison to the pollination of the intact and undamaged stigma — increases as well as the number of seeds per fruit. When removing different amounts of various parts of the pistil, i.e., when gradually shortening the path of the pollen tube, fruit setting and the number of seeds per fruit are reduced.

Introduction

It has been revealed that crossings between families, species, varieties and — according to most recent data —, even within varieties it is difficult or even impossible to make crossings. A comparison of the data in literature shows that there might be three causes of non- or difficult crossability in case of fertile pollen: 1. the pollen is unable to grow a tube because of the inhibitory matter in the style and on its surface, 2. the pollen grows a tube which cannot reach the embryo sac owing to the great distance and 3. the pollen tube penetrates the embryo sac but genetic causes inhibit fertilization.

Several authors have proved the existence of substances stimulating and inhibiting the development of pollen tubes in in vitro circumstances. HRABETOVA—TUPY (1964) noted mono- and polysaccharides (stachyose, saccharose, glucose), VASIL (1964) boron, FÄHNRICH (1964) aluminium, yttrium, indol-3-acetic acid, while BREWBAKER—KWACK (1964) found the calcium ion as having a stimulating effect on the growth of pollen tubes. Substances hindering the growth of pollen tubes are much less known in literature. BREWBAKER—KWACK (1964) describe the inhibiting effects of $CuSO_4$, and HRABETOVA—TUPY (1964) that of fructose.

Among in vivo circumstances ROSEN (1964) proved the existence of substances in the stigma stimulating the growth of pollen tubes. MIKI-HIROSIGE (1964) studied the effect of different parts of the pistil on the growth of pollen tubes. According to their studies the greatest effect was produced by the

stigma or by its surface, much less effect was produced by the style and even less by the embryo sac. The ovule resulted in the stimulation of growth only in sporadic instances. GLENK (1964), in studying the *Oenothera* species, noted a sexual affinity when crossing between varieties which had been manifest in inducing the growth of the pollen tube by the chemotropic materials of the stigma. HECHT (1964) traced substances inhibiting the growth of pollen tubes of rather an incompatible substance. JASUDA (1933) grew the pollen of *Petunia violacea* Lindl. in different culture media and found that the percentage value of the tube growth of pollen increased and the growth of the pollen tube also became quicker when an extract made of the stigma of *Solanum melongena* L. had been added to the culture medium rather than when with an extract of the stigmata of *Solanum gilo* Raddi had been done so. It has still not been possible to identify in an in vivo condition the chemical composition of the substances stimulating and inhibiting the growth of pollen tubes.

In our studies we were concerned with the first and second causes of non- or difficult crossability. According to our assumptions the effect of inhibitory substances in the stigmata and on their surfaces, or in the style, ceases if the stigma itself or the style is removed and the pollen placed on the cut surface of the remaining sections. The removal of the different parts of the pistil or rather removing different amounts of them results in the shortening of the path of the pollen tube too.

Materials and Methods

The plants tested were *Solanum melongena* L. and the *Solanum gilo* Raddi. We used two varieties of the *Solanum melongena* L. species according to FILOV's system (1958): *S. melongena* L. ssp. *occidentale* Haz. var. *bulgaricum* Fil. (Common violet eggplant) and *S. melongena* L. ssp. *subspontaneum* Fil. var. *leucoum* Alef. (Commonwhite eggplant). The morphological properties of the two varieties of *S. melongena* L. and of the *S. gilo* Raddi were described by PÁL—MÁNDY (1963) and PÁL—RAJKI (1966).

Examinations were made on plants grown in greenhouses. We were interested in discovering the degree of fertilization of the undamaged styles when checking the quality of castration and in case of the different methods of pollination of eggplants among the circumstances provided by the greenhouse. Three different methods of treatment and pollination were used in our studies; these served the purposes of control and as the basis of comparison:

a) Castration and isolation. Before the anthers ripened the buds had been castrated with tweezers and isolated.

b) Self-pollination. The buds were isolated with cellophane.

c) Free-pollination. The buds were only marked with labels.

In all treatments or rather pollinations, the development of fruit took place entirely under an isolator.

Three treatments were employed when removing the parts of the pistil or various amounts of them:

A) Removal of the stigma.

B) Removal of half the style.

C) Removal of the entire style.

Pollination was done in all three treatments after the removal of the particular section. At the time of pollination all the pollen of the three ripe anthers was placed on the cut surface after the removal of the stigma in treatment A, on the cut surface in the centre of the style for treatment B and on the cut surface at the apex of the ovary in treatment C. The removal of the different parts of the pistil was accomplished in all instances by a single cut of a sharp razor

in order to avoid greater cell destruction. KOVAČIK—HOLIENKA (1963) found in case of wheat that the mechanical injury of the lobes of the style and ovary hindered fertilization and the development of seeds. In our experiments we were interested in fertilization:

1. when removing the stigma (i.e., when the inhibitory substances were removed),
2. when various amounts of the parts of the pistil were removed (i.e., when the path of the pollen tube is shortened).

Results

Among field and greenhouse conditions the fertility and sterility of different pollen (OSVALD—PÁL 1965) and, on account of the different environmental factors, fruit setting and the number of seeds per fruit are variant. Therefore we had to state among greenhouse conditions the quality of castration, fruit setting, the number of seeds per fruit in case of different methods of pollination in order to be able to evaluate the data received when removing parts of the pistil or when removing various amounts of them from plants grown in the greenhouse.

1. *Study of fertilization for different methods of pollination under greenhouse conditions*

Table 1 introduces the results of studies on pollination which provide the basis for control and comparison among such circumstances.

In Table 1 and following Tables we mean fruit setting by the number of fruits that contain viable seeds, i.e., which are not parthenocarpic (PÁL—OSVALD 1965). By percentage of fruit setting we mean the ratio of the number of such fruits to the number of treated flowers. Having a berry fruit under examination it was necessary to state also the number of viable seeds in the fruit as this value could only provide a clue to the degree of fertilization in a flower.

Table 1

Formation of examined characteristics in case of the various methods of pollination

Method of treatment and pollination	Variety	Percent of fruit set	Fruit			No. of seeds/ fruit
			weight dg	length cm	width cm	
Castration and	Common white	—	—	—	—	—
isolation	Common violet	—	—	—	—	—
Self-pollination	C. white	45.00	31.90	10.32	8.26	170.55
	C. violet	70.83	9.25	4.01	3.41	111.5
Free-pollination	C. white	85.00	33.03	12.63	8.50	124.8
	C. violet	90.00	13.94	6.65	5.14	68.8

a) *Castration and isolation.* No fruit setting was observed after castrating and isolating 20 buds of each of the egg plant varieties examined, thus the time and method of castration was appropriate. Flowers that have received none of their own or alien pollen are "thrown off" by the plant and not even parthenocarpic fruit is formed.

b) *Self-pollination.* Twenty buds of each eggplant variety were not castrated but only isolated. In case of these flowers occurred but self-pollination. The percentage value of the fruit setting of the Common violet eggplant was less than that of the Common white eggplants. The number of seeds in the fruits was greater in the Common violet eggplant than in the Common white eggplants.

c) *Free-pollination.* Twenty flowers of each of these two eggplant varieties were marked and they flowered in the open. In these cases both self- and alien pollination can have occurred. Similarly to the values received in case of self-pollination the percentage value of seed setting of Common violet eggplant is less than that of the Common white eggplants. The number of seeds per fruit is greater in the former than in the latter.

A comparison of the values received from self- and free pollination has revealed that the degree of fruit setting, i.e., the number of fruits containing viable seeds, is greater in case of self-pollination while the number of seeds per fruit is reduced in both instances without changing the proportion of the two varieties.

2. *Study of fertility when removing various amounts of different parts of the pistil*

Different parts of the pistil were removed from the Common white and violet eggplant. Three combinations of crossings were employed: within and between varieties and between species. In this latter case the father plant used for pollination was *Solanum gilo* Raddi.

a) *Crossings within varieties.* There were two combinations in crossings within varieties. The first is when the Common violet eggplant could be fertilized with the pollen of individuals belonging to the same variety. The second combination occurred when the same had been done on the Common white eggplant. The percentage values of the fruit settings of the two combinations and the number of seeds per fruit are indicated in Table 2.

From the data of Table 2 one can learn that the varieties react differently to pollen placed on the cut surface after the removal of parts of the pistil cut off at various lengths. The Common violet eggplant "throws off" the flowers after the removal of the different parts of the pistil and after being pollinated on these cut surfaces: no fruit setting can be observed and thus no seeds develop. The Common white eggplant does not react to this mechanical interven-

Table 2

Formation of the examined characteristics in case of crosses within varieties

Combination	Method of treatment	Percent of fruit set	Fruit			No. of seeds/ fruit
			weight dg	length cm	width cm	
Common violet	A	—	—	—	—	—
×	B	—	—	—	—	—
Common violet	C	—	—	—	—	—
Common white	A	100.00	10.3	3.6	3.3	112.8
×	B	90.00	5.8	2.1	2.2	8.0
Common white	C	70.00	6.3	2.2	2.3	2.0

A = removal of stigma
B = removal of half of the style
C = removal of the entire style

tion because the fruit setting is 100% after removing the stigma, 90% after removing half of the style and 70% after removing the entire style. In treatment A the number of seeds in the fruit reaches the number of seeds in the fruits originating from self- and free pollination. Fruit setting and the number of seeds in the fruit decrease in the order of treatments (A, B, C).

b) *Crosses between varieties.* Again, two combinations were used when crosses were made between the varieties: one, when the Common violet eggplant was the mother plant and the pollen producing father plant was the Common white eggplant. In the second case it was just the reverse. Both combinations were given three treatments. Fruit setting and the number of seeds in the fruits are shown in Table 3.

Table 3

Formation of the examined characteristics in case of crosses between varieties

Combination	Method of treatment	Percent of fruit set	Fruit			No. of seeds/ fruit
			weight dg	length cm	width cm	
Common violet	A	—	—	—	—	—
×	B	—	—	—	—	—
Common white	C	—	—	—	—	—
Common white	A	90.0	11.9	3.5	3.1	57.1
×	B	80.00	7.1	2.7	2.7	24.4
Common violet	C	70.0	9.2	2.7	2.4	16.0

A = removal of stigma
B = removal of half of the style
C = removal of the entire style

As we learn from the data of this Table after removing certain parts of the pistil of the Common violet eggplant — just as in case of crosses between varieties when pollination is done on the cut surfaces — the flowers are "thrown off" and the fruit does not set. The fruit of the Common white eggplant — if after the removal of different parts of the pistil the plant has been pollinated by Common violet eggplant pollen — is not thrown off, but set in a decreasing degree according to the order of treatments (A, B, C).

c) *Crosses between species.* In this case we had only one combination, when the Common white eggplant of the *Solanum melongena* L. was pollinated by *Solanum gilo* Raddi. The mother plant was the former and the father the latter. They were also given all three treatments. According to the examinations of PÁL—RAJKI (1966) the Common white eggplant of *Solanum melongena* L. is difficult to cross with *Solanum gilo* Raddi if the pistils are intact and uninjured but if various amounts of certain sections of the pistil are removed, fruit setting occurs (as it can be seen from Table 4) and it reaches 100% when the stigmata are removed. Following the sequence of the treatments (A, B, C) fruit setting and the number of seeds in the fruit reduces.

Table 4

Formation of the examined characteristics in case of interspecific crosses

Combination	Method of treatment	Percent of fruit set	Fruit			No of seeds/ fruit
			weight dg	length cm	width cm	
Solanum melongena L*	A	100.0	1.97	3.60	3.06	55.10
×	B	85.0	2.18	3.68	3.26	40.58
Solanum gilo Raddi	C	65.0	1.19	2.88	2.71	17.15

* As mother plant we used the Common white eggplant
A = removal of stigma
B = removal of half of the style
C = removal of the entire style

Conclusions

According to our examinations when removing different amounts of the various parts of the pistil, i.e., if the stigma, half of the style of the entire style are removed, depending on the variety fruit setting will occur and seeds will be formed in the fruit. According to our data this is the property of a specific variety because the one of the varieties after being treated in such a way, "throws off" the pollinated while the fruits of the other variety are set and viable seeds develop in them, the removal of the different amounts of the

various parts of the pistil does not affect the degree of fruit setting containing viable seeds. When pollination is done with the pollen of the same variety the number of seeds in the fruits is identical with the values occurring in case of self- and free pollination under similar circumstances. When pollinating with a strange variety the number of seeds in fruit is reduced to half than is obtained for cases of self- and free pollination.

It is interesting to note that when pollinating with the same or a different variety, or in both instances the degree of fruit setting and the number of seeds in the fruit consistently reduced in accordance with the order of treatment (the removal of the stigma, half of, and the entire style). In comparison to pollination within a variety the pollination with different varieties or species also reduces the number of seeds in the fruit when removing different amounts of the various parts of the pistil. On the other hand in case of the species which are difficult to cross (*S. melongena* L., *S. gilo* Raddi) fruit setting increases two or three-fold. Fruit setting and the number of seeds in the fruit are reduced by removing different amounts of various parts of the pistil, i.e., by shortening the path of the pollen tube when crossing within and between varieties and between species. The removal of the different parts of the pistil, in case of the species difficult to cross, greatly increases the degree of crossability in comparison to pollination with intact and uninjured stigmata: this is manifest in fruit setting and in the formation of the number of seeds per fruit.

The removal of the stigmata, i.e., the removal of the substances inhibiting growth and pollen tube development, increases the degree of crossability because there increase — in comparison to the pollination of intact and uninjured stigmata — the fruit setting and the number of seeds per fruit. Removing different amounts of the various parts of the pistil, i.e., gradually shortening the path of the pollen tube, there reduces fruit setting and the number of seeds per fruit.

In conclusion the results of our examination can be summarized as follows: the crossability of species difficult to cross is increased by the removal of substances inhibiting growth and tube formation, i.e., by the removal of the stigmata.

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ORGAN FORMATION AND PROTEIN SYNTHESIS IN INSTABLE TISSUE CULTURES OF THE INTERSPECIFIC TUMOUR FORMING HYBRID OF NICOTIANA

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An instable tissue culture was obtained from the secondary tumour found in the F_2 generation of the cross between tetraploid *Nicotiana rustica* and *N. glauca*. The culture was composed of tissue parts potentially capable and incapable of organ formation. The two types of tissues (shoots and unorganized callus) can be separated and thus further cultured; they preserve their characteristics of the original organ formation. Both types of tissues easily grew on media free of both auxin and kinetin, too. The rate of protein synthesis in the small shoots of instable tissue cultures is higher at 4 and 6 weeks of age than in the undifferentiated callus parts. It is possible that secondary effects also occur in this rise of protein synthesis.

Introduction

The differentiation of tissues and organs during morphogenesis are accompanied by the quantitative and qualitative changes of DNA, RNA and protein synthesis. HOTTA—OSAWA (1958) proved that the amount of protein calculated for dry matter increased parallel with the two-dimensional growth during the development of fern prothallia. Inhibition of protein synthesis with amino acid analogs, two-dimensional growth did not occur and the prothallia grew in a thread-like way.

JENSEN (1957, 1958), HEYES (1960) and OLSON (1964) proved that protein synthesis increased in the tissues of plants in the phase of cell elongation during their ontogenesis.

The stimulated growth of tissue cultures is always accompanied by increased proteins synthesis (STEWARD—CAPLIN—MILLAR 1952). Studying the proliferation of tissue cultures it became clear that parallel with growth a new type of metabolically inert protein was also formed and this intensively incorporated the radioactively labelled proline. The growth factor of coconut milk which induces the growth of tissue cultures regulates not only the rate of protein synthesis but also its turn-over (STEWARD *et al.* 1961).

Certain interspecific hybrids of *Nicotiana* show genetic instability (MOAV 1961), somatic instability (SMITH—SAND 1957). The organ forming ability, the protein synthesis of instable tissues is less known. The author, in his present experiments, studied the organ formation and protein synthesis in cultures of instable tissues.

Material and Methods

In high percent of the F_2 generation of the *Nicotiana rustica* (4n = 48) × *N. glauca* (4n = 48) hybrids formed tumours, teratomes (KOVÁCS 1964). The tetraploid *N. rustica* and *N. glauca* strains, as well as the seeds of their F_1 generation were provided by the Institute of Genetics of the Hungarian Academy of Sciences (GYŐRFFY 1963). Later the hybrid material produced by the author was used for the experiments. The cultivation and crossing of plants were performed at the Biological Station of the Eötvös University located in Alsógöd.

The experiments were performed on a tissue culture clone (strain RG44F2TS) isolated by the author from a secondary tumour. The plant which formed the secondary tumour had derived from the F_2 generation of the cross between *N. rustica* and *N. glauca*. In order to be able to make comparisons, experiments were also conducted on a callus clone (strain G4C) produced by stem pieces of tetraploid *N. glauca*.

The tissues were cultured on a medium containing mineral salts and vitamins as described by FOX (1963). Myo-inositol was not used. Amino acids were gained from "AMPERON", an enzymatically hydrolyzed casein solution (50 mg per liter). The growth factors were β-indoleacetic acid (IAA, 1.0 mg/l) and kinetin (0.1 mg/l). A 2% saccharose and 0.9% agar were also added to the culture medium. The tissue cultures were grown in darkness at 26° C.

Protein synthesis was examined in the homogenate of tissues on the basis of DL-methionine-^{35}S and DL-phenylalanine-1-^{14}C incorporated into protein.

The conditions of the experiments employed by STEPHENSON *et al.* (1956) and WEBSTER (1955) were somewhat modified. The buds and shoots of these tissue cultures were separated from their undifferentiated callus then they were homogenized with a buffered solution (20 mM K_2HPO_4, 0.2 mM Na_2HPO_4, 20 mM $MgCl_2$, 500 mM saccharose, pH 7.5) in a pre-cooled mortar using 1 ml buffer per g fresh weight. The homogenate was even diluted with a buffer (10 mM K_2HPO_4, 0.1 mM Na_2HPO_4, 10 mM $MgCl_2$, 250 mM saccharose, pH 7.5) using 2 ml of buffer per g fresh weight. Thus the final concentration of the homogenate was 333.3 mg fresh weight per ml buffer.

Then 0.3 ml of labelled amino acid solution (phenylalanine or methionine) were added to each 3 ml of the homogenate. Then it was incubated for two hours by shaking at 24—25° C. The labelled methionine and phenylalanine concentration of the incubated mixture as well as the specific activity of the isotopes are shown in Table 2.

The reaction was stopped by 3 ml solution of 20% trichloroacetic acid (TCA). The homogenate was centrifuged and the precipitate was washed twice with 5% TCA and twice with ethanol-ether in a 1 : 1 mixture. Then it was incubated at 90° C with 5% TCA for 15 minuutes and then centrifuged. The precipitate was washed twice with 5% TCA and finally the protein precipitate was dissolved in 1 N NaOH (with a two-minute 100° C treatment), then was diluted to 0.1 N.

Protein nitrogen was determined directly by Nesslerization after sulphuric acid digestion. The radioactivity of the proteins was determined by gas flow counter apparatus (Frieseke und Hoepfner G. m. b. H. Erlangen-Bruck). Efficiency, background, and self-absorption corrections were employed for the evaluation of results.

The activity of the labelled amino acids adsorbed by the proteins but not incorporated into that, were also taken into consideration for correction. (To these samples we added 0.5 ml of 20% TCA before adding the labelled amino acids to the homogenate.)

Results

The stem pieces isolated from the individuals of the F_2 generation of *N. rustica (4n)* × *N. glauca (4n)* incubated on sterile culture media form tissue cultures. The F_2 generation can be divided into two types in regard to callus formation: the plants of first type result in undifferentiated masses of callus which produce no shoots and roots in the course of culture period. The tissue cultures derived from the plants of the other type permanently differentiate shoots only, but no roots during the period of culture (the author's unpublished results). The tumour-forming plants also belong to this latter type and the RG44F2TS strain originated from one of these plants, too.

This tissue culture of tumour origin did not seem to be homogenous. In the certain parts of the callus, bud and shoot formation could be observed. Thus the cultured tissues consist of shoots and undifferentiated callus (Fig. 1). The parts having shoots were separated from the callus for further cultivation and it was noted that the tissues retained its ability of organ formation. Having isolated the undifferentiated callus it remained after several passages undiffer-

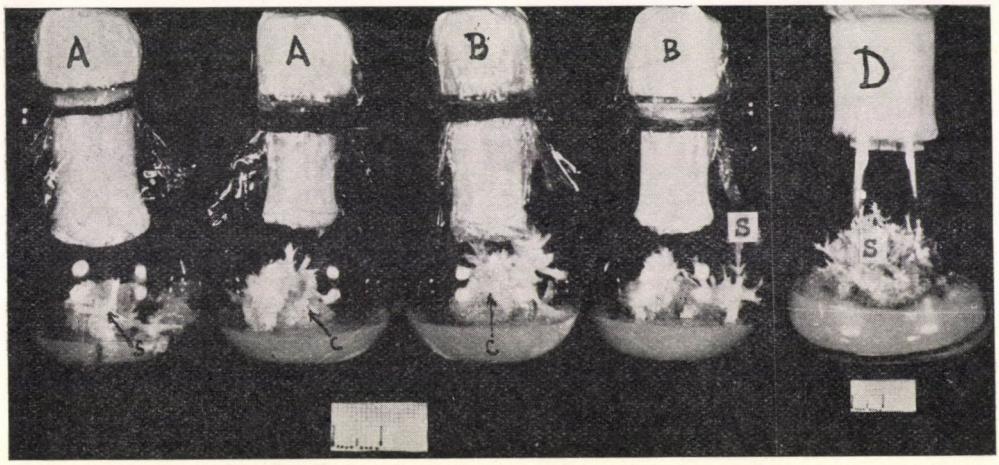

Fig. 1. Instable tissue cultures isolated from tumours with callus (C) and shoots (S); (On culture media containing IAA and kinetin: A, 4 weeks; D, 7 weeks old. On culture media containing no IAA and kinetin: B, 4 weeks.)

entiated and lacked the ability to form organs. (After several selective passages it was possible to eliminate the potentially organ-forming tissues from the original culture and thus remained a callus incapable for organ-formation.)

On this basis it was possible to conclude that the examined tissue cultures of tumour origin were unstable in regard to organ-forming ability. Evidently the original piece of tumour from which the tissue cultures originated could already contain the two different tissue (cell) types. One type is potentially organ-forming while the other has no such potentialities.

The callus potentially unable to form organs consists of large parenchymous cells. In the parenchymous tissue the sporadical netted thickening of wall of tracheide like elements is observable (Fig. 2). These elements are irregular, deformed. The shoots are covered with epidermis. Among the epidermal cells there are stomata rich in chloroplasts. Glandular hairs are as well observable on the epidermis (Fig. 2). The small shoots have continuous vascular elements with tracheae having spiral cell-wall thickening. Thus true shoots developed in the examined instable tissue cultures.

In case the RG44F2TS tissue cultures had been grown on culture media in absence of IAA and kinetin still grew well and the tissues possessing the potentiality of the organ-formation differentiated shoots. The G4C callus grew only in the presence of growth factors (Table 1).

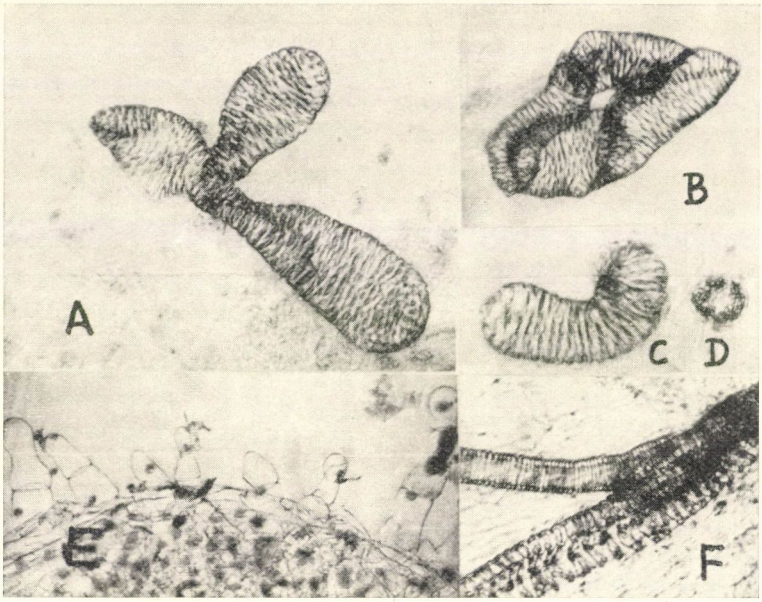

Fig. 2. Netted cell wall thickening of tracheide-like cells from callus incapable for organ formation (A, B, C). Stoma (D) and developing glandular hairs (E), visible on the epidermis of the shoots. Detail of a spirally thickening trachea from the shoots (F) of cultures

Afterwards the protein synthesizing activity of the shoots and undifferentiated callus was studied in unstable tissue cultures. The data of Table 2 show the quantities of labelled methionine and phenylalanine incorporated by the proteins of 3, 4 and 6 weeks-old tissue cultures in units of incorporated amino acid mμmol per mg protein N per hour. As it may be seen in the three

Table 1

Effect of presence or absence of growth factors on growth of tissue cultures. (4 weeks old.)

Growth factors \ Tissue strains	Gramme fresh weight ($\bar{x} \pm s_{\bar{x}}$)	
	RG44F2TS (tumorous)	G4C (normal)
With IAA and kinetin	0.909 $\pm$ 0.044	1.323 $\pm$ 0.062
Without IAA and kinetin	1.075 $\pm$ 0.050	0.065 $\pm$ 0.007

weeks old tissue cultures the rate of protein synthesis of the shoots and callus do not significantly differ and the 3—4% of deviation is unimportant. We obtained slightly higher values from the G4C callus. In the 4 and 6 weeks old tumour tissue cultures the protein synthesis of the shoots is more intensive than that of the unorganized callus. The rate of amino acid incorporation is higher (30—50 per cent) in the potentially organ-forming tissues than in the callus incapable of organ formation. It is interesting to note that in the four weeks old G4C callus cultures the quantity of the incorporated amino acid is closer to that obtained from the shoots of unstable tumour tissue cultures (Table 2).

From the experiments it seems that organ differentiation takes place much sooner than the measurable changes in the rate of protein synthesis. Thus the differences in amino acid incorporation experienced between the small shoots and calluses of four and six weeks old tissue cultures might as well reflect secondary effects.

Table 2

*The incorporation of labelled amino acids into the proteins of normal and tumorous tissue cultures**

Age of cultures	Quantity of labelled amino acids in homogenate μmol/ml	Specific activity of labelled amino acids mCi/mM	Amino acid incorporated into proteins mμmol per mg protein N per hour				
			RG44F2TS (tumorous)				G4C (normal) Callus
			Callus	Shoots	Callus per shoots	Difference in %	
3 weeks	0.191	27.3	1.46	1.54	0.96	4	—
	0.071	73.8	1.054	1.088	0.96	4	1.74
	0.071	73.8	1.24	1.20	1.03	3	1.65
	0.084	85.5	0.992	0.946	1.04	4	1.00
4 weeks	0.43	25.4	4.72	6.63	0.71	29	5.25
	0.43	25.4	4.46	6.89	0.65	35	5.95
	0.071	68.2	0.864	1.40	0.62	38	2.09
	0.084	85.6	0.737	1.41	0.52	48	1.16
6 weeks	0.071	80.6	2.32	6.63	0.35	65	0.126
	0.071	80.6	—	5.70	—	—	—
	1.13 Phe	1.56	2.935	3.515	0.83	17	—
	1.13 Phe	1.56	2.105	3.755	0.56	44	—
	0.068	86.94	1.09	1.75	0.62	38	—
	0.068	86.94	1.02	1.41	0.72	28	—

* It was the data of individual experiments that are presented in this Table because the quantity of methionine and phenylalanine (Phe) used and their specific activity varied in the different experiments. The experimental data were calculated from the averages of two parallel samples.

Discussion

According to the data of the experiments at least two genetically different cell types can be distinguished with regard to organ-forming ability in the instable tissue cultures of the tumour. From this it seems to follow that the tissues of the original tumour from which the cultures have originated perhaps were likely inhomogeneous. The tissues capable and incapable of organ formation also seem to have the tumorous characteristics (at least if judged on the basis of growth-factor independence).

If only one tissue type it would have comprised the isolated RG44F2TS cultures it would be impossible to isolate tissues capable and incapable of organ formation, because among the given conditions of experiments, uniformly the tissues should have formed shoots. Supposedly they are not the cells of homogeneous meristematic tissue that differentiate into cells of shoots, but the cells of one of the components of a heterogeneous tissue, only. In the other tissue component the ability of organ formation may be lacking. The present results show a similarity to the experiences with crown gall tumours. Cell types having different degrees of organ forming ability were also found among crown gall tumour cells (BRAUN 1962). But for the formation of crown gall tumour the cells of a homogeneous normal tissue can be transformed into different tumour cells and the tissue becomes heterogeneous.

LIPPINCOTT—LIPPINCOTT (1962, 1964) infected carrot disks with a virulent strain of *Agrobacterium tumefaciens*. Outgrowths developed on the disks. They have been stated that the protein content of the tumorous outgrowth is higher than in the base section. Even the specific activity of a few enzymes has been higher in the outgrowths. The increase of the amount of protein obtained in the outgrowths are held to be secondary changes. These statements support the present author's results although they have compared normal to tumorous tissues.

In recent years several authors have proved that RNA and protein synthesis are essential in the processes of cell elongation (NOODÉN—THIMANN 1963, KEY 1964). Thus it might be imaginable that in the shoots of tissue cultures of tumourous origin mainly the cell elongation processes seem to be dominant after three weeks and thus one component of the increase of protein synthesis is probably related to the process of elongation.

It is known that instability and tumour formation in the interspecific hybrids of *Nicotiana* are accompanied in many instances, by chromosome aberrations and eliminations (AR-RUSHDI 1957, BURK—TSO 1960, MOAV—CAMERON 1960). It is questionable whether the instability in the author's experiments (in the tissue cultures) is also related to chromosome changes, but this has not been studied so far.

Additional examination are necessary to study which factors are essen-

tial for organ formation of tissues and their significance in the regulation of the organ formation.

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THE EFFECT OF RATE OF NITROGEN APPLICATION ON DRY MATTER YIELD AND NITROGEN FRACTIONS OF SORGHUM AT DIFFERENT STAGES OF GROWTH

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A randomized block design with 4 replicates was used to determine the response of *Sorghum vulgare* to increasing levels of fertilizer nitrogen.

Nitrogen application resulted in significant increases in both yield and protein content of the forage. The yield of crude protein was more than tripled in 1962 season when 140 lb./N fed. were applied.

Total and protein nitrogen, per gm dry matter, showed a continuous drop as growth proceeded. Nitrogen application resulted in a progressive increase in the content of these two fractions at each growth stage, but protein nitrogen, as a percentage of total nitrogen, showed, generally, a steady decrease with the increase in the level of fertilizer nitrogen.

Nitrate and other nitrogen constituted a considerable portion of the non-protein nitrogen content of sorghum at seedling and tillering stages. Ammonia and amide were, however, present in relatively small quantities. Nitrate seemed to be the principal form of nitrogen taken up from the soil. At flowering stage the nitrate-N fraction dropped to a low level, thus the consumption of forage by farm animals is recommended at this growth stage.

Introduction

Sorghum vulgare (Lur.) is the most important forage crop in the irrigated riverine areas of Northern Sudan. The variety Abu Sabein is assuming an increasing importance in dairy farms which are rapidly developing around expanding towns. Despite its importance technical information concerning its production and feeding value is seriously lacking. Experimental work on sorghum in the Sudan has been very limited and was mostly concerned with grain production. This state will, no doubt, seriously jeopardize the efficient production of forage sorghum which is much needed to cope with the demands of rising standards of living in a developing country.

The importance of nitrogenous fertilizer as a means of increasing dry-matter yields of grasses has been demonstrated by numerous workers (Burleson *et al.*, 1956; Holmes *et al.*, 1960; Brockington, 1962 and many others). Under Sudan conditions Crowther, (1942); Ferguson—Gray, (1949) and Last, (1960), using the hard seed stage for the assessment of fertilizer response, reported significant increases in both heads and straw yields of sorghum following the application of nitrogenous fertilizers.

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The effect of added nitrogen on the crude protein content of herbage has been shown by many workers (BURLESON *et al.*, 1956; DOTZENKO, 1961; SMITH, 1961; BROCKINGTON, 1962 and many others). Working with sorghum, BURLESON *et al.*, (1956) found a significant increase of protein in grain and forage following the application of nitrogenous fertilizer. The apparent nitrogen recovery was 83.2 and 89.6 per cent when 60 and 120 pounds of nitrogen per acre were added, respectively. The non-protein nitrogen constituents, particularly the nitrate N, of grasses were shown to increase with the application of high levels of nitrogenous fertilizer (FERGUSON—TERRY, 1957 and NOWAKOWSKI, 1961). ANNISON—LEWIS (1959) state that the reduction of nitrate in the rumen can under certain conditions lead to the formation of nitrite in quantities sufficient to poison the animal. It is, therefore, possible that addition of high rates of nitrogenous fertilizer may produce forage in which the nitrate content is increased to the extent which would cause physiological upsets to farm animals.

It is the object of this investigation to provide information on the effect of nitrogen application on dry-matter yield, crude protein content and the nitrogen fractions of forage sorghum at different stages of growth under arid zone conditions.

Material and Methods

Two field experiments were carried out in two different sites in the Experimental Farm of the Faculty of Agriculture at Shambat in 1961 and 1962 seasons. *Sorghum vulgare* (Lur.) var. Abu Sabein was used for the purpose of this investigation.

The experiments in both seasons were laid down in a randomized block design with four replicates; individual plots were 6×7 metres (1/100 feddan).* Nitrogen was applied, at sowing, as sulphate of ammonia 21% N at the rate of 0.0, 20, 40, 60, 80, 100, 120 and 140 pounds of nitrogen per feddan.

Sorghum grains and fertilizer were broadcast on the flat. Each plot was then made up into eight ridges of 7 metres each. This method is generally used in the irrigated areas to ensure that both grain and fertilizer are mostly inside the ridges (as a precaution against water logging at the time of germination).

Plots were irrigated independently according to the usual practice. Two ridges were discarded on either side of each plot and samples were taken from the four central ridges to avoid border effect. The samples were collected, on area basis, at seedling, tillering and flowering stages. The seedling samples were treated as a whole, but at the two latter stages the plants were dug out and dissected into roots and shoots. The samples were weighed and then dried in an electric oven at 70° C until constant dry weight was reached. The dried samples were weighed for dry weight determinations, finely ground and kept for analysis of various nitrogen fractions.

Analytical methods

Duplicate samples (1.0 gm. each) of the ground material were extracted with distilled water using trichloroacetic acid for the precipitation of proteins. The suspension was filtered through Whatman No. 1 filter paper, made up to a known volume with water, a few drops of toluene added and the extract was analysed for its various soluble nitrogen fractions. These fractions were: the total non-protein nitrogen (NPN), ammonia-, amide-, amino- and nitrate-nitrogen. The residue was dried and used for the determination of protein-nitrogen.

* A feddan = 0.42 hectare.

The protein-nitrogen was determined on two weighed portions of the dried residue by the micro-Kjeldahl method using H_2SO_4 and K_2SO_4 : $CuSO_4 \cdot 5H_2O$ (3 : 1) as catalyst.

The total non-protein nitrogen was determined in the protein-free extracts by the micro-Kjeldahl method, modified to include nitrate as outlined by PUCHER *et al.* (1930). The nitrate nitrogen was independently determined by the reduced iron method of VICKERY—PUCHER (1929).

The ammonia and amide nitrogen fractions were determined according to the method described by VARNER *et al.* (1953). The amino nitrogen was determined according to the method given by POPE—STEVENS (1939). Residual nitrogen was calculated as the difference between the total NPN and the sum of the various soluble nitrogen fractions.

Results

The full data are set out in Tables 1—7. Each of the figures reported represents the average of four replicates. *Yields of dry matter:* Dry matter yields resulting from the respective fertilizer treatments in both 1961 and 1962 seasons are recorded in Table 1. Marked increases in forage yields were obtained by nitrogen application. In the seedling stage the increase in dry matter in both seasons was significant but inconsistent with the applied levels of nitrogen. At tillering the increase in forage yield reached the significant level in 1962 season only; the maximum increase in yield was obtained in both seasons with the 100 lbs of nitrogen. The yield at flowering ranged from a minimum of 2763 kgm per feddan in 1961 season and 4579 kgm per feddan in 1962 under the O-nitrogen level to a maximum of 4646 and 9334 kgm per feddan in 1961 and 1962 seasons, respectively. Differences in dry matter production for the various levels of nitrogen were highly significant. In 1961 season there was

Table 1

The effect of nitrogen application on the dry-matter yield of forage sorghum at various stages of growth
(Calculated as kgm dry matter/Fed.)

Nitrogen applied lb/F.	1961			1962		
	Seedling stage	Tillering stage	Flowering stage	Seedling stage	Tillering stage	Flowering stage
0.0	32.6	649.6	2762.8	37.1	724.0	4578.5
20	49.4	828.5	3179.9	54.7	943.5	5770.3
40	42.4	887.9	3617.5	55.1	1027.0	6527.3
60	49.2	964.1	3801.7	65.7	1226.0	6870.3
80	46.8	970.0	4101.6	51.7	1332.5	7623.8
100	61.8	1011.1	4646.4	54.3	1466.5	8459.5
120	46.2	973.4	4553.7	55.7	1376.0	9184.8
140	46.8	956.2	3944.9**	55.1	1242.0**	9333.8**
S. E.	± 4.9	± 57.0	± 51.43	± 7.08	± 79.2	± 580

** = Highly significant.

Table 2

The effect of nitrogen application on the crude protein yield of forage sorghum at various stages of growth
(Calculated as kgm/Fed.)

Nitrogen applied lb/F.	1961				1962			
	Seedling stage	Tillering stage	Flowering stage	% recovery	Seedling stage	Tillering stage	Flowering stage	% recovery
0.0	7.8	99.5	101.7		8.5	62.6	113.1	
20	11.8	135.5	137.1	62.9	12.6	90.7	135.6	40.0
40	10.2	166.1	169.1	59.9	13.8	111.7	166.5	47.4
60	12.2	188.7	192.7	53.9	16.7	163.9	197.4	49.9
80	11.8	198.5	215.5	50.6	12.9	199.6	246.1	59.1
100	15.6	213.5	266.6	58.6	13.9	224.8	291.0	63.2
120	12.3	206.1	268.5	49.7	13.5	221.0	340.7	67.4
140	11.9	206.7**	237.4	34.4	14.1	227.8**	368.2**	64.8
S. E.	± 1.23	± 12.3	± 1.9		± 1.65	± 12.4	± 22.1	

** = Highly significant.

a drop in forage yield with the application of 120 and 140 lbs N per feddan. Differences between the yields at flowering in the two years were very great; in 1962 season the dry matter yield was almost double that of 1961 season which was a bad growing season.

Yields of protein: Yields of crude protein (N $\times$6.25) for the three growth stages in 1961 and 1962 seasons as well as the nitrogen recovery are recorded in Table 2. In general, increasing rates of nitrogen fertilizer increased the yield of crude protein of the forage. The differences in crude protein yield between the nitrogen levels were highly significant in the tillering and flowering stages of both growing seasons. The yield of protein was almost doubled in the tillering and flowering stages of 1961 season, and more than tripled in both stages of 1962 season. Such an increase was greater than the increase in dry matter production. This indicates that nitrogen fertilizer application was more effective in increasing the nitrogen content rather than the dry matter of the forage.

The percentage nitrogen recovery was calculated to better visualize the effects of different levels of nitrogen upon forage sorghum. In 1961 season, the recovery showed a decline with increasing the level of applied nitrogen. In 1962 season, the recovery showed a continuous, although not steady, increase with the increase in the level of applied nitrogen. This indicates that sorghum in 1962 used higher nitrogen rates more efficiently than in 1961, presumably due to greater proliferation of the sorghum root systems throughout the soil profile in 1962 than in 1961 season. Furthermore, stem-borer attack was more severe in 1961 than in 1962 season.

Table 3

The effect of nitrogen application on the different nitrogen fractions in sorghum seedlings.
(calculated as mgm N per gm dry matter)

Nitrogen fraction	Year	Nitrogen Applied (lb./ Fed.)								S. E.
		0	20	40	60	80	100	120	140	
Ammonia-N	1961	0.32	0.37	0.48	0.47	0.50	0.47	0.48	0.42	±0.035
	1962	0.16	0.17	0.18	0.19	0.22	0.21	0.22	0.25	±0.014
Amide-N	1961**	0.66	0.77	0.86	0.83	0.91	1.01	1.05	1.06	±0.036
	1962**	0.62	0.77	0.78	1.01	1.00	1.23	1.16	1.34	±0.048
Amino-N	1961	1.72	1.50	1.79	2.07	2.00	2.52	2.73	2.45	±0.219
	1962**	1.93	2.24	2.45	2.45	2.49	2.45	2.59	2.66	±0.027
Nitrate-N	1961*	1.83	2.48	2.37	2.45	2.24	2.44	2.75	2.52	±0.110
	1962**	1.90	2.43	2.76	2.61	2.85	3.10	3.28	3.43	±0.129
Other-N	1961	3.97	3.48	3.12	3.38	3.30	3.50	3.86	3.64	±0.340
	1962	3.97	3.91	4.15	4.55	4.65	4.03	4.02	4.01	±0.184
Total NPN	1961**	8.50	8.60	8.62	9.20	8.95	9.94	10.85	10.09	±0.260
	1962**	8.68	9.52	10.32	10.81	11.21	11.02	11.27	11.69	±0.188
Protein-N	1961	29.93	29.80	29.88	30.63	31.30	30.58	31.88	30.57	±0.620
	1962	28.38	27.53	27.75	29.58	28.83	29.75	27.68	29.05	±0.480
Total-N	1961	38.43	38.40	38.50	39.83	40.25	40.52	42.74	40.66	±0.710
	1962**	36.96	37.05	38.07	40.39	40.04	40.77	38.95	40.74	±0.490

* = Significant.
** = Highly significant.

Table 4

The effect of nitrogen application on the different nitrogen fractions in sorghum shoots at tillering stage (calculated as mgm N per gm dry matter)

Nitrogen fraction	Year	Nitrogen applied (lb./ Fed.)								S. E.
		0	20	40	60	80	100	120	140	
Ammonia-N	1961**	0.64	0.58	0.68	0.73	0.81	0.90	0.83	0.74	±0.046
	1962**	0.15	0.19	0.19	0.22	0.23	0.25	0.29	0.28	±0.010
Amide-N	1961**	0.64	0.66	0.72	0.86	0.84	1.02	0.92	0.97	±0.037
	1962**	0.17	0.28	0.36	0.33	0.44	0.50	0.57	0.61	±0.020
Amino-N	1961**	1.37	1.54	1.86	2.14	2.00	2.42	2.28	2.49	±0.136
	1962	—	—	—	—	—	—	—	—	—
Nitrate-N	1961**	1.15	1.52	2.70	3.52	3.74	4.02	4.35	4.77	±0.240
	1962**	0.13	0.27	0.63	0.87	1.53	2.55	2.85	5.01	±0.350
Other-N	1961	2.38	2.57	2.21	3.02	3.23	3.26	3.21	3.30	±0.220
	1962**	2.07	2.16	2.39	3.59	4.09	4.03	3.86	4.39	±0.330
Total NPN	1961**	6.00	6.87	91.7	10.27	10.62	11.62	11.59	12.27	±0.400
	1962**	2.52	2.90	3.57	5.01	6.29	7.33	7.57	10.29	±0.580
Protein-N	1961**	18.50	19.30	20.77	21.05	22.12	22.17	22.29	22.52	±0.276
	1962**	11.35	12.32	14.05	16.68	17.35	17.43	17.93	18.95	±0.450
Total-N	1961**	24.50	26.17	29.94	31.32	32.74	33.79	33.88	34.79	±0.572
	1962**	13.87	15.22	17.62	21.69	23.64	24.76	25.50	29.24	±0.860

** = Highly significant.

Table 5

The effect of nitrogen application on the different nitrogen fractions in sorghum roots at tillering stage
(calculated as mgm N per gm dry matter)

Nitrogen fraction	Year	Nitrogen applied (lb./Fed.)								S. E.
		0	20	40	60	80	100	120	140	
Ammonia-N	1961*	0.56	0.56	0.56	0.65	0.61	0.76	0.70	0.71	±0.030
	1962	0.07	0.07	0.07	0.10	0.11	0.09	0.10	0.09	±0.007
Amide-N	1961	0.67	0.82	0.89	0.88	1.02	1.07	0.93	1.00	±0.060
	1962**	0.15	0.24	0.28	0.43	0.49	0.59	0.65	0.73	±0.036
Amino-N	1961**	0.76	1.30	1.54	1.37	1.65	1.93	1.58	1.65	±0.120
	1962**	0.14	0.18	0.39	0.46	0.60	0.60	0.63	0.81	±0.040
Nitrate-N	1961**	0.98	1.20	2.00	2.48	2.75	2.97	3.24	3.44	±0.110
	1962**	0.22	0.37	0.62	0.95	1.45	1.95	2.58	3.13	±0.155
Other-N	1961	1.32	1.34	1.68	1.64	1.51	1.72	1.59	2.12	±0.184
	1962**	0.80	1.10	1.37	1.82	1.98	2.33	2.50	2.78	±0.220
Total NPN	1961**	4.29	5.22	6.67	7.02	7.54	8.45	8.04	8.92	±0.215
	1962**	1.38	1.96	2.73	3.76	4.63	5.56	6.46	7.54	±0.350
Protein-N	1961**	7.22	7.69	7.88	7.94	8.03	8.87	8.75	8.76	±0.197
	1962**	4.37	5.27	5.84	6.45	6.64	6.83	7.55	7.58	±0.200
Total-N	1961**	11.51	12.91	14.55	14.96	15.57	17.32	16.79	17.68	±0.320
	1962**	5.75	7.23	8.57	10.21	11.27	12.39	14.01	15.12	±0.500

* = Significant.
** = Highly significant.

Table 6

The effect of nitrogen application on the different nitrogen fractions in shoots and roots of sorghum at the flowering stage
(calculated as mgm N per gm dry matter)

Nitrogen fraction	Year	Nitrogen applied (lb./Fed.)								S. E.
		0	20	40	60	80	100	120	140	
		Shoots								
Total NPN	1961**	1.20	1.40	1.58	1.77	1.88	2.24	2.10	2.17	±0.07
	1962**	1.35	1.40	1.55	1.58	1.80	1.90	2.01	2.30	±0.08
Protein-N	1961**	4.69	5.50	5.90	6.34	6.53	6.94	7.34	7.46	±0.07
	1962**	2.70	2.70	2.75	2.99	3.38	3.60	4.04	4.35	±0.17
Total-N	1961**	5.89	6.90	7.48	8.11	8.41	9.18	9.44	9.63	±0.18
	1962**	4.05	4.10	4.30	4.57	5.18	5.50	6.05	6.65	±0.18
		Roots								
Total NPN	1961**	1.10	1.17	1.33	1.40	1.54	1.87	2.00	1.94	±0.03
	1962**	1.27	1.33	1.47	1.69	1.91	2.35	2.55	2.85	±0.07
Protein-N	1961**	3.50	3.77	3.93	4.09	4.28	4.62	5.10	5.00	±0.05
	1962**	2.16	2.30	2.38	2.44	2.79	2.96	3.21	3.58	±0.18
Total-N	1961**	4.60	4.94	5.26	5.49	5.82	6.49	7.10	6.94	±0.07
	1962**	3.43	3.63	3.85	4.13	4.70	5.31	5.76	6.43	±0.21

** = Highly significant.

Behaviour of the various nitrogenous fractions

The results of the analyses of various nitrogenous fractions are represented in Tables 3—6. The ammonia-, amide-, amino- and nitrate-N contents of sorghum at the stages of flowering were very low and not recorded in Table 6.

The data reveal the following main points:

1. The contents of the various nitrogenous fractions were generally higher in shoots than in roots.

2. The total-N content of sorghum expressed as mgm N per 1 gm dry matter was greatly increased with nitrogen application. In the seedling stage in both seasons the differences in the total nitrogen content between the various levels of applied nitrogen were very small and insignificant. In the two latter growth stages, these differences were significant.

With all nitrogen treatments the total-N content fell as the sorghum advanced from the seedling to the flowering stage.

The differences in total nitrogen content between the two years in the seedling stage ware very small in all nitrogen treatments. Such differences were much more exaggerated at tillering and flowering stages. In 1961 season the total nitrogen was consistently higher than in 1962 season, presumably because of the poor growth of sorghum in the former season. Poor growth, undoubtedly, increases the nitrogen concentration of the cells.

The protein and total non-protein nitrogen fractions showed the same trend as the total nitrogen fraction. When the protein nitrogen figures of the forage are expressed as percentages of total nitrogen it is evident that fertilizer application resulted in decreased protein percentages. This reduction in protein values was rather slight in the flowering stage; the values were 79.4% and 69.1% with no nitrogen compared with 77.4% and 65.4% when 140 lb. N/Fed. were applied in 1961 and 1962, respectively. In the tillering stage the protein per cent of total nitrogen dropped considerably with the increase in level of applied nitrogen. The values ranged from 75.5% with No to 64.7% with N_7 in 1961 and from 69.1% to 65.4% in 1962.

The protein percentages in the root were lower than those in the shoot in both tillering and flowering stages, but, as in the shoot, their values dropped progressively with the increase in the applied level of nitrogen (Table 7).

3. The nitrate-nitrogen content of sorghum showed apparent variations with the stage of growth. The highest nitrate-N percentages were recorded in the tillering samples in both shoots and roots. At flowering, the nitrate-N content dropped to a very low level, presumably being assimilated into peptides and proteins. The 5-days old sorghum seedlings contained an appreciable amount of nitrate-N, indicating an early uptake of soil nitrogen.

Nitrogen application significantly increased the nitrate-N content of sorghum plant. This effect was more marked at tillering stage when the nitrate-

N percentages of total-N of shoot varied from an average of 2.8 at O-nitrogen level in the two years to 15.5 with the application of 140 lb. N per feddan.

Nitrate-nitrogen content of sorghum also showed seasonal variations. At seedling stage the nitrate-N content was consistently higher in 1962 than in 1961 season; but at tillering such fraction in both root and shoot showed greater accumulation in 1961 than in 1962 season. This feature, coupled with the high yield of nitrogen in 1962, might indicate higher uptake and faster assimilation of nitrate-N in 1962 than in 1961 season.

4. Ammonia and amide-N fraction were present in relatively small quantities in the sorghum seedlings and in both roots and shoots at tillering stage and they generally, although not invariably, increased slightly with the rate of nitrogen application.

5. A considerable portion of the total non-protein nitrogen content of the 5-days old seedlings, roots and tops of sorghum collected at tillering was in the form of amino (except in tops of 1962) and other nitrogen. These two fractions showed a tendency to increase with the rate of fertilizer application.

Discussion

The data presented in this investigation indicate that the dry matter yield of sorghum was significantly increased by nitrogen application. The maximum increase over O—N level amounted to 1791 kgm in 1961 and 4755 kgm in 1962 when 100 and 140 lb. N/Fed. were respectively used.

Of interest to feed processors and livestock farmers is the effect of nitrogen fertilization on the protein yield. As compared with 101.7 and 113.1 kgm of protein per feddan produced without nitrogen, the application in 1961 of 120 and in 1962 of 140 lb. N/Fed. resulted in yields of 237.4 and 368.2 kgm of protein, respectively. The lower increments in both forage and protein yields in 1961 than in 1962 were associated with low percentages of nitrogen recovered in protein form. Numerous investigators (BURLESON *et al.*, 1955; REICHMAN *et al.*, 1959; SMITH, 1961 and many others), have demonstrated similar increases in both yield and protein content of forage due to application of nitrogenous fertilizers.

The forage and protein yields showed also progressive increase in the successive stages of growth. The increase in dry weight of tops collected at tillering was associated with a more or less corresponding increase in crude protein. At flowering, the great increase in forage yield was accompanied by a slight increase in the protein yield. This feature may indicate a low rate of nitrogen uptake at this growth stage.

Results depicted in Tables 3—7 reveal that the total nitrogen (mgm/gm dry matter) underwent a continuous decrease in the successive stages of growth.

Table 7

Effect of nitrogen application and stage of growth on the percentages of protein to total nitrogen in sorghum tops and roots

Nitrogen applied lb./F.	Sorghum tops sampled at				Sorghum roots sampled at			
	Tillering		Flowering		Tillering		Flowering	
	1961	1962	1961	1962	1961	1962	1961	1962
0.0	75.5	81.3	79.4	69.1	62.7	76.0	76.1	62.9
20	74.1	80.9	79.7	65.8	59.5	72.9	76.3	63.3
40	69.4	79.7	78.9	64.0	54.1	68.1	74.7	61.8
60	67.2	76.8	78.2	65.4	53.1	63.1	74.5	59.1
80	67.5	73.4	77.6	65.2	51.6	59.8	73.5	59.1
100	65.6	70.4	75.6	65.4	51.2	55.1	71.2	55.7
120	65.7	70.3	77.5	66.7	52.3	53.8	71.8	55.7
140	64.7	64.8	77.4	65.4	49.5	50.1	72.0	55.6

This is interpreted as a rate of growth exceeding the rate of nitrogen uptake. Through nitrogen fertilization the total nitrogen was increased significantly in each growth stage.

Most of the nitrogen taken up by the sorghum plants was elaborated into proteins. This is clear from the high percentages of protein to total nitrogen in both shoots and roots (Table 7). These percentage values of protein showed a continuous drop with the increase in level of applied nitrogen. This may indicate that the rate of protein synthesis was not proceeding in proportion to the level of non-protein nitrogen.

Nitrate nitrogen forms a considerable portion of the NPN in early stages of growth, but as plants reached maturity the nitrate-N content dropped to a very low level. Nitrate accumulation could be explained as being the result of a rate of uptake exceeding the rate of nitrate nitrogen utilization.

The higher nitrate-N contents of sorghum at seedling and tillering stages when compared with the content of ammonia-N may indicate that most of the nitrogen taken up by sorghum plants was in the form of nitrate ions. This fact supports the contention that nitrate constitutes the most important source of nitrogen for cultivated plants. In this investigation, the added ammonium salt may be partly bound by being strongly held to base exchange materials in the soil as it contained much clay and humus (cf. RUSSEL, 1952) and partly transformed by the nitrifying bacteria to nitrate which remained available to sorghum plants.

The incorporation of nitrate nitrogen into the organic-nitrogen compounds of plants may involve its reduction to nitrite and then ammonia before its assimilation (PRYANISHNIKOV, 1931 and CHIBNALL, 1939). On the other hand,

BURSTRÖM (1945) doubts that nitrate assimilation in higher plants, particularly in the chlorophyll-containing parts, involves reduction to the ammonia level. In this investigation nitrite was detected in sorghum stem and root but no significant change in ammonia-N content was observed even when nitrate nitrogen level reached 20 per cent of NPN Ammonia-N, eventually resulting from nitrate reduction may be utilized in the amination of keto acids to form their corresponding amino acids from which peptides and proteins were formed. This view is substantiated by the appearance of significantly increasing amounts of amino acids in most samples collected at seedling and tillering stages. The failure to detect any amino-N in sorghum tops collected at tillering in 1962 may be accounted for by its very rapid synthesis into peptides and proteins. Alternatively, nitrate may be converted to some rather complex organic form without first being reduced to ammonia.

The increase in nitrate-N of the forage resulting from nitrogen fertilization is of great significance in the feeding of farm animals. Little hazard seems to be attached to the nitrate itself but its reduction in the rumen to nitrite may cause death of the animal if its critical amount is exceeded. ANNISON—LEWIS (1959) stated that the toxic dose of sodium nitrate is 1 gm. per kgm body weight when given orally. This dose is equivalent to 164.7 mgm nitrogen for each kgm. of the animal live weight.

A consideration of the effect of nitrogen fertilization on the nitrate-N content of the forage indicates that the nitrate nitrogen level in the seedling stage did not reach the toxic level even when 140 lb. N/Fed. were applied and the feeding rate was at 4.7% of the animal body weight. It is also very unlikely that stock will be fed on the seedling stage of Abu Sabein because of the very low dry matter at this stage. In the tillering stage the toxic level of nitrate nitrogen was not approached until the feeding level was above 3%. It is worthy of mention, here, that Abu 70 is not commonly fed to animals at this stage but it may be grazed under certain conditions. However, it is highly improbable that animals will be allowed to take all their ration from such grazing. The usual stage in which the fodder is consumed is the flowering stage in which the total NPN content is very low and thus does not constitute any danger of poisoning to animals.

Tables 3—6 also show that a considerable part of the NPN content of sorghum tops and roots was in the form of "other nitrogen", the amide and ammonia nitrogen being present in relatively small quantities. In this connection it may be mentioned that roots of plants receiving nitrate are characterized by being relatively poor in amide and amino nitrogen and relatively rich in "other nitrogen" (cf. STEWARD—STREET, 1947).

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FERTILIZATION CONDITIONS OF BERRY FRUIT VARIETIES

III. RASPBERRY, BLACK-, RED CURRANT

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Raspberry. The 14 raspberry varieties examined are self-fertilizing. The higher fruit setting per cent in open pollination (40—90%) prove the necessity of pollinating varieties. Parthenocarpic trend in the raspberry varieties was very weak (1—2 per cent).

Black currant. Fertilizing ability of the 21 varieties examined is very variable. Practically self-sterile varieties are: *Baldwin*, *Boskoop Giant*, *Lees Black* and *Wellington*. The other varieties tested are self-fertile between 20 and 80 per cent. Parthenocarpy and apomixis could be also demonstrated and particularly the trend in the variety *Goliath* (F) is remarkable.

Red currant. The self-fertilizing ability of the 14 varieties examined is variable. 80—90% results of open fertilization prove that higher yields can be obtained with proper pollinating varieties. The parthenocarpic trend in the red currant varieties is very poor. It has occurred to a lower per cent in *London Market*, *Nagymarosi* and *Kaukázusi piros*.

Introduction

The necessity of examination for the fertilization conditions in berry producing fruit varieties has been thoroughly treated by SELJAHUDIN—BRÓZIK (1965).

Material and Method

Methodical literature concerning the biology of flowering in berry producing fruit varieties can be found in SELJAHUDIN—BROZIK's paper (SELJAHUDIN—BROZIK, 1965) which includes also a most detailed analysis of examination methods applied here.

Results and Discussion

Raspberry

Investigations were conducted in two series, between 1959—1962 with *Antwerpse Gelb*, *Fertődi 401*, *Hornet*, *Knewett*, *Lloyd George* (H), *Lloyd George* (T), *Malling Promise*, *Nagymarosi*, *Preussen*, *Superlativ* (T), *St. Walfried*, subsequently from 1963—64 also with the varieties *Malling Exploit*, *Taylor* and *Wädenswil Red*.

Owing to abnormal weather conditions only the data of the years 1960—1961 and 1964 can be evaluated.

According to examinations "A" open fertilization was in case of 14 raspberry varieties between 40 and 90 per cent. This — in 9 cases — exhibits higher values than self-fertilization (Tests "B"—"B_1"—"C").

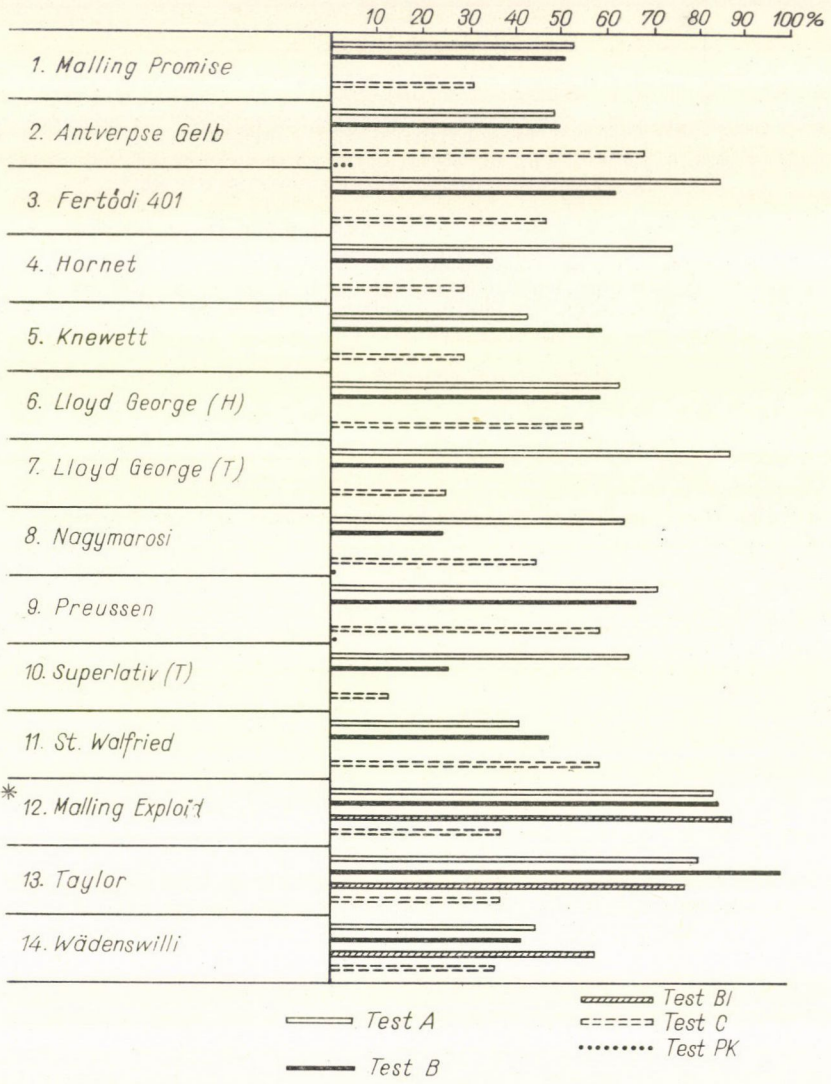

Fig. 1. 2 year average results of fertility tests in raspberry varieties (1960—61) from sign* 1964. Érd-Elviramajor

These data agree with those of LOGINYCHEVA (1960) who stresses that raspberry is a readily self-fertilizing plant but planted with proper foreign varieties may yield even 100 per cent more. This is also supported by BULLMANN (1961) who, with reference to LOGI (1958), states that although rasp-

berry is self-fertilizing, the varieties yield better with open flowering. Referring to KOBEL he also concludes that only the male sterile varieties are not self-fertile as e.g. the raspberry variety *Fastolff*. PORPÁCZY (1962) also states that according to observations made up to now the raspberry varieties are self-fertilizers and inter-incompatibility is unknown among them. SZILÁGYI (1960) points out that a positive correlation can be demonstrated between earliness and per cent of self-fertilization in the varieties.

Our own tests "B"—"B_1"—"C" also support that raspberry is a readily self-fertilizing plant. In the majority of cases the per cent of selfing is above 40 per cent. Even in varieties where the average per cents are under 40, in some years, results occur above 40 per cent (Fig. 1).

In the hybridization of raspberry varieties among each other test "D", similarly to test "A" it was found that the raspberry varieties readily fertilize each other. Especially outstanding results have been obtained from the following combinations:

Lloyd George (H) × *Malling Promise*, *St. Walfried*, *Malling Exploit*, *Wädenswil Red.*

Malling Promise × *Lloyd George*, *Wädenswil Red.*

Malling Exploit × *Lloyd George* (H), *Nagymarosi.*

Nagymarosi × *Lloyd George*, *St. Walfried*, *Wädenswil Red.*

Wädenswil Red × *Lloyd George*, *Malling Promise.*

St. Walfried × *Fertődi 401*, *Nagymarosi.*

The parthenocarpic trend in the raspberry varieties is very poor. It may occur in some years with one variety or the other: *Preussen*, *Antwerpse Gelb*, *Nagymarosi*, but the results of 1—2 per cent obtained are practically irrelevant.

Black currant

Fertilization tests of the black currant varieties were also carried out in two series. From 1958 to 1962 with 8 varieties: *Baldwin*, *Boskoop Giant* (not identical with the pomologically described *Boskoop Giant)*, *Goliath* (H), *Goliath* (F) (not identical with the pomologically described *Goliath)*, *Hosszúfürtű fekete*, *Lees Black*, *Silvergieter*, *Wellington* and subsequently from 13 newer varieties: *Amos Black*, *Altayskaya dessertnaya*, *Boskoop Giant* (English) true, *Daniel's September*, *Laxton's Raven*, *Mendip Cross*, *Naryadnaya*, *Neapolitanskaya*, *Neosipayushchayasya*, *Rosenthals Schwarze*, *Stahanovka*, *Vistavochnaya* and *Wellington XXX*.

Examinations carried out in 1959 were not apt to be evaluated.

According to the results of the "B" and "C" tests there are very considerable differences, concerning the degree of selfing, between the black currant varieties.

As practically self sterile varieties can be regarded *Baldwin*, *Boskoop Giant*, *Lees Black* and *Wellington*.

It is remarkable that the combinations *Wellington* × *Baldwin* and *Baldwin* × *Wellington* did not consistently supply, in the course of years a result. It must thus be concluded — what has not yet been discussed in literature — that these varieties must be regarded as mutually sterile, intersterile varieties. This is the more a grave phenomenon since these two varieties are also otherwise self sterile. Thus these two varieties neither in themselves nor planted beside each other supply a yield.

The majority of varieties is sufficiently self-fertile, except for the four varieties listed. When establishing a varietal ranking, the following picture is obtained.

The self-fertilizing per cents of the "B"—"B_1" tests are between 20—80 per cent. The selfing ability of varieties was ranged in two classes:

1. sufficiently self-fertile 20—40%,
2. readily self-fertile 40—80%.

Distribution of varieties:

1. Sufficiently self-fertile varieties: *Amos Black*, *Goliath* (H), *Hosszúfürtű fekete*, *Silvergieter*, *Altayskaya*, *Vistavochnaya*, *Neosipayushchayasya*, *Mendip Cross*, *Daniel's September*, *Laxton's Raven*, *Neapolitanskaya*, *Rosenthals Schwarze*, *Boskoop Giant* (English).

2. Readily self-fertile varieties: *Goliath* (F), *Stahanovka*, *Wellington XXX*.

It should be noted that the "B_1" tests in black currant varieties generally yield a 10—40 per cent better result. Thus, from varieties ranged into group 1 the varieties *Vistavochnaya*, *Neosipayushchayasya*, *Laxton's Raven*, *Neapolitanskaya*, *Rosenthal's Schwarze* and *Booskop Giant* (English) fall into the readily self fertile group 2.

The result of the "C" test is generally in agreement with that of test "B". A difference is constituted by *Altayskaya d.*, *Goliath* H and *Silvergieter* where a 10—30 per cent higher fruit setting has been obtained. So these varieties are also ranged into the readily selfing group (Fig. 2).

Hosszúfürtű fekete and *Silvergieter* are, in our varietal collection, morphologically quite similar. Therefore, the denomination "*Hosszúfürtű*", can be considered in our opinion, as a synonym.

The variety *Boskoop Giant* according to data in foreign literature (Loginycheva 1950—1958 and Klämbt 1958) is readily self-fertilizing. Bullmann (1961) mentions that in the black and red currant varieties highly and poorly self-fertilizing varieties can be distinguished. In this connection he refers to the similar statements of Schanderl, Klämbt, Neumann, Loginycheva. He considers the varieties *Rosenthal* and *Boskoop* as poorly self-fertilizing while *Silvergieter* and *Goliath* as readily self-fertilizing. In contrast to our observations he found that *Silvergieter* gave a better yield with its own pollen than with the

foreign one and concludes that these readily self-fertilizing varieties can be planted also in homogeneous stands. NEUMANN (1955) considers the varieties *Goliath* and *Boskoop Giant* as readily selfing. On the other hand, contrary

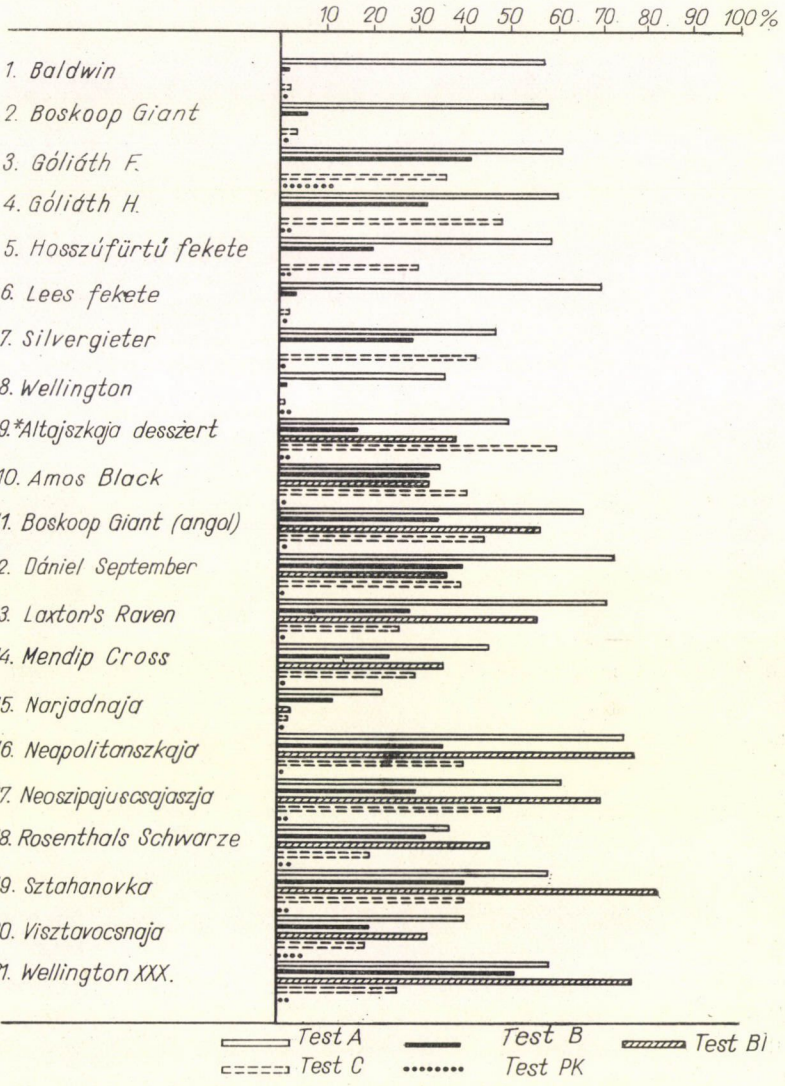

Fig. 2. 3 year average results of fertility rests in black currant varieties (1958—1960—1961) from sign × 1964. Érd-Elviramajor

to our own results, he established that the readily self-fertilizing varieties revealed, even under favourable conditions of cross pollination, a low degree of fertilization. RUDLOFF—SCHANDERL (1950) in generally find with the currant, self-fertilization dominating and the fruits obtained from self pollination

were, also according to these authors, of normal development. PORPÁCZY (1962) states that among the black currant varieties produced in Hungary *Silvergieter*, *Goliath* and *Hosszúfürtű* are sufficiently self-fertilizing. He found the varieties *Boskoop Giant* and *Rosenthal* to be self-fertile. For these he considers *Goliath* and *Silvergieter* as good pollinating varieties. He also established that the domestic and foreign observations concerning the fertilization conditions of black currant varieties were in some cases contradictory. This, also according to these authors, may be attributed to the examinations having been conducted on non-identical clones or to the environmental effect greatly influenc-

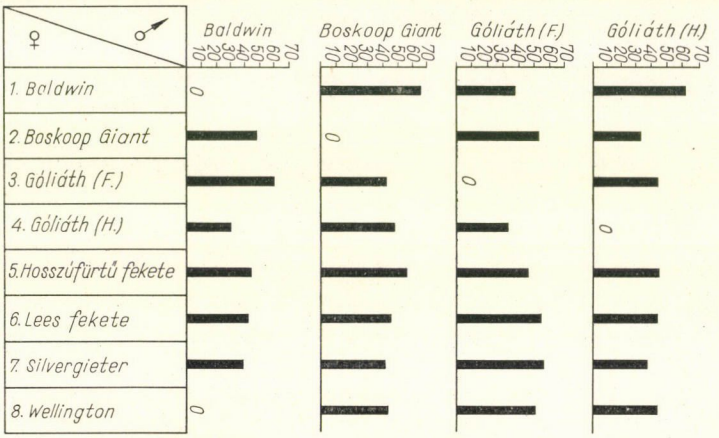

Fig. 3. Combinations of black currant varieties among each other (Test D) (1958—1962)

ing this property. He also refers to the majority of authors (SCHANDERL 1958, HILKENBÄUMER—KLÄMBT 1958) who are in agreement that the black currant varieties in mixed planting produce a better yield.

On account of varietal differences which may arise we refer to the characterization of the questionable varieties examined by ourselves. The variety widespread in Hungary under the name *Boskoop Giant* and examined by ourselves is not identical with the variety studied by the above authors, as it is different both morphologically and to the degree of selfing. The variety *Boskoop Giant* (an English one) originating from West-Germany and included in our collection, coincides with the variety examined by these authors and has been found to be self-fertile also in our tests.

The two varieties *Goliath* included in the test are not either morphologically or biologically identical. From the varieties *Goliath* (F) (French) and *Goliath* (H) (Dutch) according to Soviet and to Western literature the variety *Goliath* (H) (Dutch) is the original one.

The yield increasing effect of the foreign pollen is sharply reflected not only by self-sterile but also by self-fertile varieties. The values of the "A" tests in

the varieties examined are well balanced, the values obtained are around 50—80 per cent.

Tests "D" that is combinations among varieties yielded very good results.

On searching for proper pollinating partners (1958—62) we had examined in our earlier tests all the eight varieties for each combination.

In the individual combinations the varieties *Boskoop Giant*, *Goliath* F, *Goliath* H and *Wellington* proved to be the best pollinating varieties.

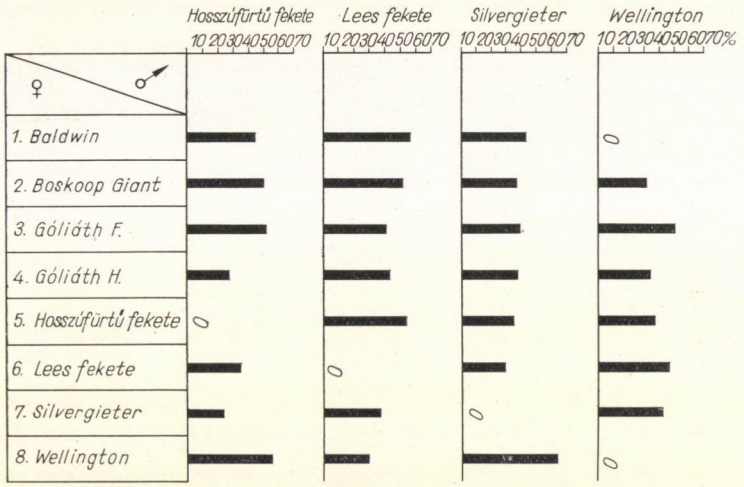

Fig. 4. Combinations of black currant varieties among each other (Test D) (1958—1962)

Highest fruit setting was obtained in the combination *Wellington* × *Silvergieter*, poorest in *Silvergieter* × *Hosszúfürtű* and *Goliath* H × *Hosszúfürtű* (Figs. 3—4).

In the examination of the forthcoming series newer varieties were also included in the tests. These were conducted in two directions. On the one hand, the three best varieties chosen and widespread also in practice — *Boskoop Giant*, *Silvergieter* and *Goliath* H. were pollinated with the new varieties and, reciprocally, the new varieties with the above-mentioned ones.

The direct and reciproque pollinations yielded very reassuring results. It appeared that the black currant varieties mutually fertilized each other without difficulty. Fertilization per cents are between 40 and 60.

In reciproque hybridization, when the three selected varieties were pollinated, similarly good results were obtained. The results of the pollination are again between 40 and 60 per cent on the average (Figs. 5, 6).

In the "PK" tests of black currant varieties we found that among the varieties tested, 5 exhibited various degrees of parthenocarpic trend. In some

varieties (e.g. *Goliath* H., *Wellington* and *Lees Black*) this was not found to be consistently characteristic. In two varieties — *Silvergieter* and *Hosszúfürtű* — it occurred in 2 years each. For the variety *Goliath* F it should be specially stres-

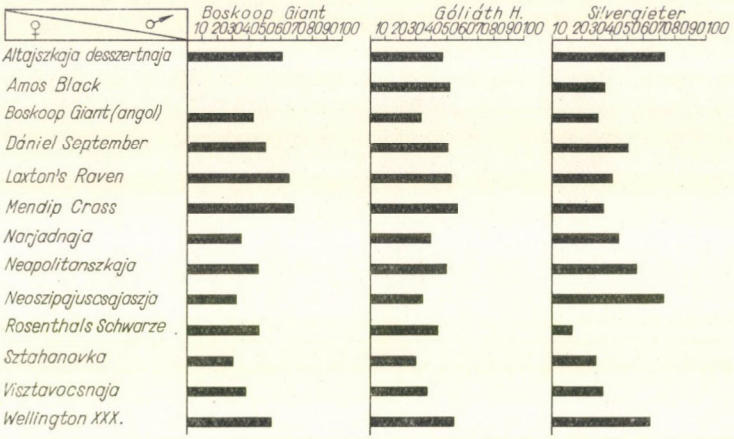

Fig. 5. Combinations of black currant varieties among each other (Test D) (1963—1964)

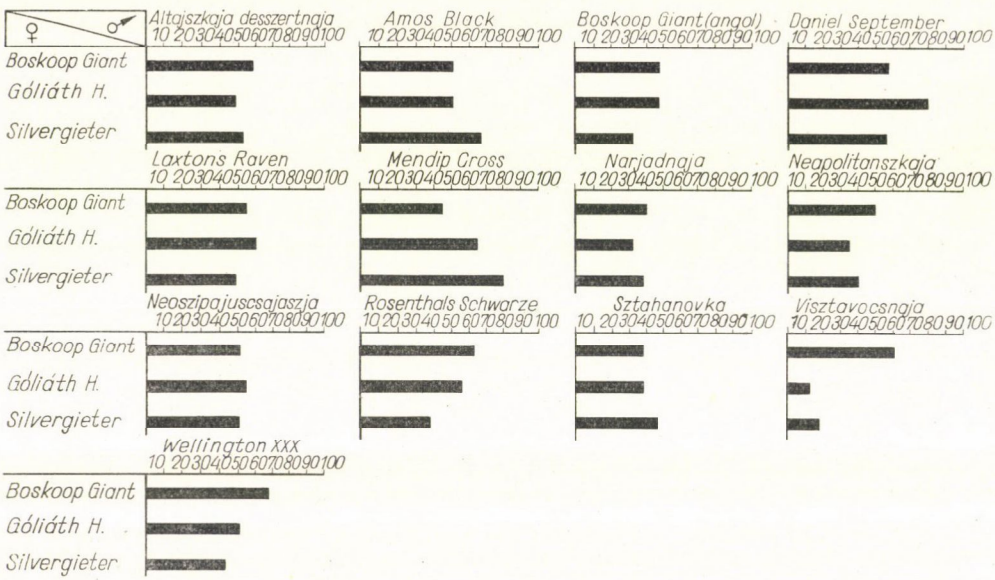

Fig. 6. Combinations of black currant varieties among each other (Test D) (1964)

sed that the experience was made in four consecutive years with a result varying between 3.6 and 25.3 per cent. In this variety a low number of seeds was obtained from the parthenocarpic fruits, consequently here also apomixis was encountered.

Our finding concerning *Goliath* F does not agree with the statement of PORPÁCZY (1962) according to which the variety *Goliath* (H) is liable to apomixis without special induction. He found that the black currant varieties *Goliath* (H) and *Amos Black* tended definitely to apomixis.

The two different statements are presumably based on an error, owing to the different properties of the two varieties *Goliath*.

Contrary to the Hungarian data RUDLOFF—SCHANDERL (1950) made the striking statement concerning the currant that in no case could parthenocarpy be detected.

In connection with black currants also PORPÁCZY (1962) found that with induction parthenocarpic fruits could be brought about in the varieties *Silvergieter*, *Boskoop Giant* and *Rosenthal*. Lately ZATYKÓ—SIMON have succeeded in inducing apomictic fruit development with synthetic auxine and gibberellic acid treatment.

Red currant

Conditions of fertilization were examined from 1958—61 and on newer varieties in 1964 that is in four years. From the results the data of 1959 cannot be utilized. Also the evaluation of the tests "C" and "D" encounters difficulties because — owing to the small size of the flowers — castration is very difficult and causes many injuries which naturally affects the results.

Self-fertilization of the examined varieties has been proved though the average per cents are generally lower and fluctuate between 20 to 40 per cent. The degree of self-fertilization largely depends, also here, on variety, weather and plant conditions plus the fact that the flowers, at the end of the stem set on most rhapsodically. This is aggravated by the spring frosts and the cold rainy periods damaging mostly the varieties blooming in the second half of the period of flowering.

Varieties examined: *Erstling aus Vierlanden*, *Fay's prolific*, *Houghton Castle*, *Heinemanns Rote Spätlese*, *Heros*, *Hollandi fehér*, *Holländer Rote*, *Jonkheer von Tets*, *Kaukázusi piros*, *London Market*, *Nagymarosi piros*, *Prolific*, *Red Lake*, *Versailleser Rote*. From the 14 red currant varieties four in agreement with literature (KLÄMBT, BULLMANN) are very poorly self-fertilizing; these are *Heros*, *London Market*, *Holländer Rote*, *Erstling aus Vierlanden*. In these varieties self-fertilization according to test "B" is about 3—20 per cent.

In six varieties self-fertilization was 20 to 40 per cent while four varieties: *Red Lake*, *Jonkher van Tets*, *Nagymarosi*, *Kaukázusi piros* show a lower or higher self-fertilization changing between 40 and 60 per cent and *Heinemanns Rote Spätlese* above 60 per cent.

The red currant varieties need identically foreign pollen to obtain a proper yield. This is evidenced by the data on open fertilization where in the case

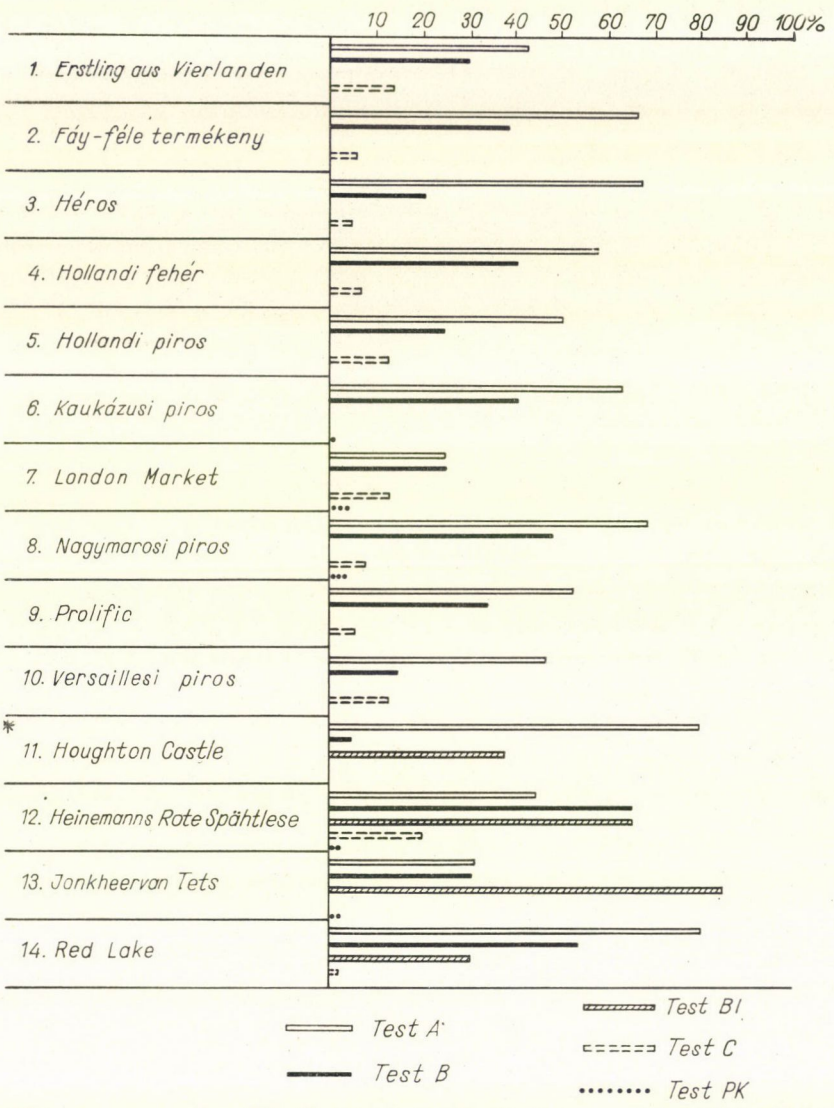

Fig. 7. Year average results of fertilization tests of red currant varieties (1958—1960—1961) from sign* 1964. Érd-Elviramajor

of most varieties 80 to 90 per cent fruit setting has been found. Outstanding was the fertilization in *Red Lake*, *Kaukázusi piros* and *Nagymarosi*. With the variety *Heros* e.g. where self-fertilization hardly reaches 20 per cent in case of open fertilization, on being planted together with other varieties, fruit setting was 91—47—66 per cent, respectively (Fig. 7).

Fertilization conditions of red currant varieties are discussed by the authors together with black currant and therefore the conclusions drawn there

are also valid here. PORPÁCZY (1962) stresses that fertilization conditions of red currant varieties are less known. As to the varieties examined KLÄMBT (1958) found that *Heros*, *Hollandi piros* and *Heinemanns Rote Spätlese* were partly self-sterile. BULLMANN (1961) found the varieties *Hollandi piros*, *Rote Vierländer*, *Heinemanns Rote Spätlese* and *Heros* poorly self-fertilizing and stressed that foreign pollen was needed for better yields.

The combinations included in the trial, although we used from 1958 on many varieties and replications, did not supply, owing to difficulties outlined above the expected result.

The following combinations yielded satisfactory results: *London Market* × *Jonkher* v. *Tets*, *Heinemanns Rote Spätlese* × *London Market*, *Nagymarosi*, *Heros* × *Erstling aus Vierlanden*, *Houghton Castle* × *London Market*.

In the years to follow the search for the best varietal combinations must be continued.

According to our examinations the parthenocarpic trend in the red currant varieties is very poor: from 14 varieties examined it only occurred to an insignificant percentage in *London Market*, *Nagymarosi piros* and *Kaukázusi piros*. In the parthenocarpic fruits a small number of seeds was found. These findings are corroborated by the relative literature. PORPÁCZY (1962) in *Fay*'s red currant varieties found also parthenocarpic trend and states that in some red currant varieties parthenocarpy can be induced.

Conclusions

Raspberry

The 14 raspberry varieties examined are self-fertilizing.

The higher fruit setting per cent in open pollination (40—90%) prove the necessity of pollinating varieties.

Lloyd George (H), *Malling Promise*, *Wädenswil Red* and *St. Walfried* have been found to be the best pollinating partners.

Parthenocarpic trend in the raspberry varieties was very weak (1—2 per cent).

Black currant

Fertilizing ability of the 21 varieties examined is very variable.

Practically self-sterile varieties are: *Baldwin*, *Boskoop Giant*, *Lees Black* and *Wellington*.

The other varieties tested are self-fertile between 20 and 80 per cent.

Open fertilization generally results in higher fruit setting.

The varieties *Wellington* and *Baldwin* are mutually sterile (interincompatible).

In the various combinations *Boskoop Giant*, *Goliath* (H), *Goliath* (F) and in the trial with newer varieties *Boskoop Giant* and *Silvergieter* or reciprocally *Wellington XXX*, *Mendip Cross*, *Laxton's Raven*, *Rosenthals Schwarze* and *Amos Black* have proved to be the best pollinating partners.

Parthenocarpy and apomixis could be also demonstrated and particularly the trend in the variety *Goliath* (F) is remarkable.

Red currant

The self-fertilizing ability of the 14 varieties examined is variable.

Very poorly self-fertile (3—20 per cent) are: *Heros*, *London Market*, *Holländer Rote*, *Erstling aus Vierlanden.*

Medium self-fertile (20—40%) *Fáy féle termékeny*, *Hollandi piros*, *Prolific*, *Versaillesi piros* and *Houghton Castle.*

Readily selfing (40—60%) *Red Lake*, *Jonkheer van Tets*, *Nagymarosi*, *Kaukázusi piros* and *Heinemanns Rote Spätlese.*

80—90% results of open fertilization prove that higher yields can be obtained with proper pollinating varieties.

The parthenocarpic trend in the red currant varieties is very poor. It has occurred to a lower per cent in *London Market*, *Nagymarosi* and *Kaukázusi piros.*

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DATA ON THE POSSIBILITIES OF CONTROLLING POTATO VIRUS

III. EXAMINATIONS WITH THE DUTCH METHOD

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Our studies done with the Dutch method revealed that potato virus X and potato virus S infections had not been reduced in comparison to the untreated control plots and infection of potato virus S had increased in case of certain varieties *(Gülbaba, Kisvárdai Rózsa, Somogyi Korai, Somogyi Sárga)*.

Concerning the yields which were unfavourably affected by the extremely dry weather, it was noted that at the optimum time of de-stemming (July 12) the yield had been 57.6% less than that of the controls.

The infection of potato virus Y and potato leaf-roll virus has been reduced with 16.5 percent (average of varieties) compared to the check provided the de-stemming has been done before the mass-flight of the aphid vectors. At a later de-stemming, the occurrence of potato virus Y and potato leaf-roll virus was raised, but has occurred in the period between 12 and 21 July. The higher sugar content of the early de-stemmed tubers (compared to the check) could not be proven.

Introduction

Probably one of the most effective methods in the struggle against potato viruses spread by vectors is de-stemming, the so-called Dutch method. Its introduction has been brought about by the fact that in certain years the summer migrants of *Myzus persicae* Sulz. has appeared early, at the beginning of the growing season and that if these winged individuals have invaded from the nonselected, highly-infected potato plots to the selected seed potato plots they have caused a strong primary virus infection. In order to outrule this possibility the early interruption of the connection between stem and tuber was introduced. The premature interruption of development has been known for many years: including the fundamental method of MORREN (cit. LARGE 1940) it has a past of more than one hundred years. Nevertheless up to the present time it has still not been unambiguously proved that the interruption of assimilatory activity is free of risk. The procedure is, however, known to be widespread and its popularity is increasing. In Holland, KOOSTERMAN (1962) reported that the method of early harwesting had been introduced as early as 1930 and from 1940 onwards a compulsory harwesting time had been fixed annually depending on the size of the aphid populations. Early harwesting was changed in 1946 on account of the poor storing qualities of certain varieties to de-stemming

(SALZMANN 1950, DE LINT 1958) which is today known as the de-stemming method. On the basis of the Dutch experiences the number of publications released in recent years in the different countries is almost innumerable. The scope of this study does not permit the evaluation of these in detail and therefore we must be content with quoting only a few publications, though this is not anything near the complete listing (ARTNER 1959, BIRECKI—GABRIEL 1962, BLASZYK 1959, BOOCK 1962, BOTHE 1961, CRUCQ—DE LINT 1955, CUNNINGHAM *et al.* 1952, EHRENFORS 1960, FISCHNICH—THIELEBEIN 1958, GOERLITZ 1955a, b, HERBER 1963, HOFSTEIN 1960, HÜLSMANN 1963, JERMOLJEV—PRUSA 1961, JOSEPH *et al.* 1957, KELLER—MÜNSTER 1961, KELLER—WEISS 1956, KOROHODA—MILCZAK 1960, LEHMANN-BECKOW 1963, LÜDDECKE 1956, MALEC 1960, MÜNSTER 1952a, b, 1958, PEHOVAK 1964, PFEFFER 1959, SHAW 1955, SCHICK 1953, SCHLEUSENER 1954, SCHWEIGER 1961, WRIGHT—HUGHES 1964, etc.).

In Hungary SZIRMAI (1939) was to introduce the de-stemming method of growing seed-potatoes. Recently the works of TEICHMANN (1959), HINFNER—CSÁK (1960), BOCZ (1960), FORGÓ (1962), RÉTHY (1963, 1964) treated in detail the perspectives of the application of this method in Hungary. The work of SCHÜLLER (cf. 1963) gives a comprehensive survey of the problems included in literature and involved in the method. Regarding pathology, the effectiveness of the method achieved general satisfaction in the early period of its application. The opinions on the economic aspects of the question were frequently contradictory because the expenses of the method had exceeded the expenses of conventional potato production. Therefore, in recent years defoliation with herbicides and mechanization supplanting manual haulm-pulling and leaf cutting (the latter even have unfavourable effects; ARENZ 1959) have become increasingly widespread.

The results achieved by both methods have been so far excellent in special regard to manpower usage and the increasing labor shortage. Undoubtedly the aforementioned methods are, however, far from being perfect. Secondary effects as for instance certain defoliants damaging the tubers (SALZMANN 1963 cit. KÖHLER 1964, GUSTAFSSON 1964, WENZL 1965, the oral communications of GIMESI—HINFNER), the toxicity to humans (RAINISS 1962, BOTHE 1963, RÉTHY 1964) and the unfavourable affect on second crops (WENZL 1958) produce a lot of disagreement on their use. KABIERSCH (1963) is of the opinion that the penetration of the tuber by the herbicides or the various defoliants and the consequent damaging must certainly be regarded as inconclusive.

Besides the unfavourable effects it must be stated without the shadow of a doubt that the early interruption of ripening in many respects (increase of tillering ability, vigour of quick development, tendency to flower earlier, etc.) has favourable effects on the seed-potatoes (SALZMANN 1948, KÖRNER 1950, etc.).

The recognition of the stimulating affect on the yield (NEITZEL—PFEFFER 1959) has given a new swing to research. But in the pathologically and economically oriented studies of earlier years little attention was paid to those physiological and biochemical effects without which the method cannot be correctly judged. Recently these questions have been extensively treated and the results achieved up to now have considerably broadened our knowledge of the theme and brought us closer to a fuller understanding of the problem (FISCHNICH 1959, JERMOLJEV—PRUSA 1961, BREYAN *et al.* 1962, HEILINGER 1963, cf. KÖHLER 1964).

Material and Methods

Our experiments were carried out at the Plant Growing Experiment Station of the College of Agriculture at Keszthely with potato varieties produced for our experiments in 1961 (HORVÁTH 1966a). The different varieties were forced (pre-treated) between February 15 and April 8 of 1962 with the method described in an earlier publication of the present author (HORVÁTH 1966b). Following the tuber selection carried out on the basis of light effects the different varieties were planted in 100-hill plots with row and hill distances of 70 and 35 cm., respectively, on April 9 and 10.

The experiments were done in 4 replications and 7 treatments. Among the 7 treatments one was the control and in case of 6 treatments de-stemming was done at different times between June 30 and August 18. Manual de-stemming (haulm pulling) was purposely used in the experiments for at the time of the experiment there had been no tested effective herbicides available in Hungary.

During the growing period selections were made in the experiments on three occasions (May 5—9, May 21 and June 4).

Results

1. Virus infection

During the experiments the degree of virus infection of the different varieties was stated for the different de-stemming dates in the second year of growing (Table 1). The results show that the incidence of potato virus X and

Table 2

Results of the examination of the value number of Infection

Name of variety	Value of infection (Total occurrence of viruses)		
	1961	1962	1963
Somogyi Kifli	106	57	59
Gülbaba	143	107	98
Kisvárdai Rózsa	118.5	82	78
Mindenes	95	41	62
Somogyi Korai	87.5	46	55
Somogyi Sárga.....	87.5	51	77

Table 1

Results of the virus examinations in the second year of growth in %

Name of variety	Treatments							Number of selected plants (1962)
	1	2	3	4	5	6	7	
	Time of de-stemming							
	18. 8.	31. 7.	30. 6.	10. 8.	12. 7.	21. 7.	Control	
Somogyi Kifli	7/7/36/10[a] 60/17[b]	5/7/40/8 60/15	5/6/41/2 54/8	7/9/39/6 61/15	6/6/38/4 54/10	6/6/35/9 56/15	6/7/40/11 59/18	27
Gülbaba	22/8/51/22 103/30	20/6/61/20 107/26	18/3/58/10 89/13	16/7/54/16 93/23	20/3/56/10 89/13	19/5/55/17 96/22	21/6/50/21 98/27	41
Kisvárdai Rózsa	10/10/41/18 79/28	15/8/35/19 77/27	12/5/36/6 59/11	11/10/38/18 77/28	12/6/41/6 72/12	13/6/39/6 63/12	12/10/36/20 78/30	61
Mindenes	2/2/36/22 62/24	1/1/38/16 56/17	—/1/36/2 39/3	2/3/37/18 60/21	1/—/30/3 34/3	3/—/41/8 52/8	2/2/38/20 62/22	26
Somogyi Korai	3/11/32/12 58/23	1/8/36/14 59/22	3/1/40/5 49/6	3/8/30/13 54/21	2/2/33/5 32/7	4/5/30/10 49/15	2/10/31/12 55/22	20
Somogyi Sárga	2/6/38/30 76/36	3/5/34/10 52/15	3/5/34/5 52/10	4/6/40/26 76/32	3/3/37/8 47/11	2/3/40/10 50/13	3/8/36/28 77/36	27

Note: a) The first, second, third, and fourth arabic numerals indicate the occurrence of potato virus X, potato virus Y, potato virus S and potato leaf-roll virus, respectively.

b) The numerator contains the value of virus infection (total occurrence of viruses) and the denominator contains the total occurrence of potato virus Y and potato leaf-roll virus.

potato virus S do not differ for the various dates of de-stemming. The early interruption of the growing period (June 30) reduced the infection of potato virus Y and potato leaf-roll virus in all varieties. In comparison to the control the over-all infection of potato virus Y and leaf-roll virus were reduced by 8% for *Somogyi Kifli*, 14% for *Gülbaba*, 18% for *Kisvárdai Rózsa*, 19% for *Mindenes*, 15% for *Somogyi Korai* and 25% for *Somogyi Sárga*. The next date of de-stemming (July 12) seems to show no increase whatsoever in comparison to the June 30th treatment in regard to the incidence of potato virus Y and potato leaf-roll virus spread by vectors. But the incidence of viruses markedly increased everywhere for the second year of growing on those plots where de-stemming had been done after July 21. The incidence of potato virus Y and potato leaf-roll virus showed an even greater increase whenever de-stemming had been done even later, but they were far from being so intensive as between July 12 and 21. The results of our examination are faithfully reflected by the results of the biological examinations of vectors. The experiments of BORUS *et al.* (1965) stated that the maximum aphid infection had occurred on July 11 and showed an essential reduction on the 18th of July; at the end of the month the aphids had disappeared.

When examining the indices of infection it became clear that the incidence of viruses had been reduced although in comparison to the data of 1961 — but relative to the observations of 1962 — it had risen in case of certain varieties (Table 2). Although the incidence of viruses spread by vectors and also of potato virus X could be essentially reduced (Table 3) the occurrence of potato

Table 3

Comparison of the occurrence of the individual viruses

Name of variety	Occurrence of viruses in%							
	1961				1963[a]			
	PVX[b]	PVY[c]	PVS[d]	PLRV[e]	PVX[b]	PVY[c]	PVS[d]	PLRV[e]
Somogyi Kifli	15	33.5	32.5	25	6/6	6/7	38/40	4/11
Gülbaba	22	12.5	69.5	39	20/21	3/6	56/50	10/21
Kisvárdai Rózsa	13.5	9	39	57	12/12	6/10	41/36	6/20
Mindenes	8	5	59	23	1/2	—/2	30/38	3/20
Somogyi Korai	11.5	13.5	48.5	14	2/2	2/10	33/31	5/12
Somogyi Sárga	10	11	35.5	31	3/3	3/8	37/36	8/28

Note: a) The numerator contains the figure for the virus infections of the second year of growing of plots de-stemmed on July 12 and the denominator the figure of the virus infection of the second year of growth of the control plots
b) Potato virus X
c) Potato virus Y
d) Potato virus S
e) Potato leaf-roll virus

virus S considerably increased — especially in 1963 — resulting in the unfavourable change of the indices of infection.

2. *Yields*

The yields were closely related to the time of the interruption of the growing period. In case of the earliest de-stemming date (June 30) the total yield was generally 66.2% less for the average of all varieties than for the controls. The optimum de-stemming date (July 12) produced in all instances 57.6% less yield among the test plots than among the controls (Table 4). When the date of de-stemming was July 21 the test plots produced 45% less than the controls. But on the average potato virus Y and potato leaf-roll virus show a total increase of 5% which, pathologically speaking, implies a loss greater than the 12.6% yield gain in comparison to the earlier de-stemming (July 12). According to the experimental data, therefore, if de-stemming is done at the optimal time we have to count on great losses in yield in order to gain relatively healthy seed-potatoes. Nevertheless it must be emphasized that in the spring of 1962 the weather warmed up much slower and during vegetation precipitation was on the average 25 mm. less than the mean amount of 40 years (HORVÁTH 1966b, Table 4). In my view if the planting had been done in time and the weather had been better, as well as favourable precipitation, the yield would have been essentially higher at the time of aphid infestation. In the experiments it was observed whether the early harvesting is followed by reduc-

Table 4

Examination of the yield

Name of variety	Average yield per plant 1961 dkg/plant	Treatments							In the second year of growth 1963 dkg/plant
		1	2	3	4	5	6	7	
		Date of de-Stemming / Date of harvesting							
		18. 8. / 6. 9.	31. 7. / 21. 8.	30. 6. / 23. 7.	10. 8. / 31. 8.	12. 7. / 1. 8.	21. 7. / 8. 8.	Control / 24. 9.	
Somogyi Kifli	30	36	25	16	28	20	23	40	
Gülbaba	25	25	15	10	20	14	15	28	30/32[a]
Kisvárdai Rózsa ...	80	95	80	31	93	35	60	102	20/19
Mindenes	88	76	48	28	56	33	44	96	86/84
Somogyi Korai	60	70	56	30	62	37	47	73	90/92
Somogyi Sárga.....	83	84	61	32	72	45	50	95	85/80

Note: a) The numerator expresses the results of the second year of the plots de-stemmed on July 12 while the denominator the figures for the second year of growth of the control plots

tion in the second growing of the next year. In 1963 for this reason we compared the plots de-stemmed on July 12 to the second growing of the control plots and stated that there had been no differences in the second growing (Table 4). The

Table 5

Grouping of the tubers according to standard measurements, %

Name of variety	Treatments							Standard measurement[a] mm
	1	2	3	4	5	6	7	
	Date of de-stemming / Date of harvesting							
	18. 8. / 6. 9.	31. 7. / 21. 8.	30. 6. / 23. 7.	10. 8. / 31. 8.	12. 7. / 1. 8.	21. 7. / 8. 8.	Control / 24. 9.	
Somogyi Kifli	18.4	18.9	34.6	23.6	21.9	15.1	30.9	0—34
	71.1	73.2	60.9	65.2	73.9	77.5	58.2	35—79
	7.3	5.4	4.5	7.6	4.2	6.1	6.7	80—100
	2.6	2.5	—	3.6	—	1.3	2.3	101—120
	0.6	—	—	—	—	—	1.9	above 121
Gülbaba	30.2	16.2	27.4	25.3	26.8	17.1	23.6	0—34
	60.2	76.9	70.3	62.3	67.4	75.9	66.5	35—79
	7.7	6.9	2.3	10.2	5.8	7	6.4	80—100
	1.9	—	—	2.2	—	—	3.5	101—120
	—	—	—	—	—	—	—	above 121
Kisvárdai Rózsa ...	19.9	17.2	11.9	16.5	16.7	17.5	33.3	0—34
	44.4	59.3	77.8	56.4	61.3	58.9	52.6	35—79
	21.5	19.4	10.3	19.3	19.1	16.6	7.4	80—100
	11.5	4.1	—	7.2	2.9	7	4.3	101—120
	2.7	—	—	0.6	—	—	2.4	above 121
Mindenes	32.2	34.2	66.6	37.2	32.5	30.2	47.6	0—39
	59.1	61.3	32.4	55.4	63.5	66.6	44.7	40—60
	5.6	2.6	1	7.1	4	3.2	5.2	61—80
	3.1	1.9	—	0.3	—	—	2.4	above 81
Somogyi Korai	32.8	18.5	41.8	26.8	34	21	38.2	0—39
	57.9	73.5	56.4	62.6	59.3	71.6	52	40—60
	7.4	5.9	1.8	8.1	4.9	4.8	6.3	61—80
	1.9	2.1	—	2.5	1.8	2.6	3.5	above 81
Somogyi Sárga.....	15.8	18.4	48.1	20.9	16.9	15.4	31.8	0—39
	63.5	67.9	50.8	58.2	76.5	74.3	53.2	40—60
	18.9	9.2	1.1	17.6	6.6	8.2	10	61—80
	1.8	4.5	—	3.3	—	2.1	5	above 81

Note: a) According to the Hungarian standard No. MSZ/6377/1960.

proportion of standard-sized tubers of the yield may be seen in Table 5. The results show that the highest percentage of tubers suitable for planting may be found in the plots de-stemmed on July 12 (76.6%). In the average of all the varieties the size of the seed-potatoes of the untreated control plots comprises 61.5% of the total yield.

3. *Content analysis of the potato varieties*

During the content analysis the water content of the mean sample of the different plots was reduced while their dry-matter content increased according to the successive dates of de-stemming. It was impossible to draw conclusions

Table 6

Results of the examination of the content

Name of variety	Treatments							Content analysis
	1	2	3	4	5	6	7	
	Date of de-stemming / Date of harvesting							
	18. 8. / 11. 9.	31. 7. / 26. 8.	30. 6. / 28. 7.	10. 8. / 5. 9.	12. 7. / 6. 8.	21. 7. / 13. 8.	Control / 29. 9.	
Somogyi Kifli	—[a)]	73.6	77.4	70.8	75.2	73.6	—	water
	—	26.4	22.6	29.2	24.8	26.4	—	dry-matter
	—	0.92	0.66	0.61	0.71	0.60	0.66	sugar
Gülbaba	—	77.4	29.4	77.2	78.4	77.4	—	water
	—	22.6	20.6	22.8	21.6	22.6	—	dry-matter
	—	0.49	0.54	0.39	0.45	0.56	0.64	sugar
Kisvárdai Rózsa ..	—	74.6	77.6	74.—	77.2	74.6	—	water
	—	25.4	22.4	26.—	22.8	25.4	—	dry-matter
	—	0.45	0.57	0.45	0.40	0.60	0.50	sugar
Mindenes	—	74.2	78.6	73.4	77.2	74.2	—	water
	—	25.8	21.4	26.6	22.8	25.8	—	dry-matter
	—	0.60	1.03	0.80	0.87	1.06	1.14	sugar
Somogyi Korai ...	—	77.6	79.6	77.6	78.2	77.6	—	water
	—	22.4	20.4	22.4	21.8	22.4	—	dry-matter
	—	0.48	0.76	0.24	0.46	0.39	0.24	sugar
Somogyi Sárga ...	—	78.8	81.—	77.4	79.2	78.8	—	water
	—	21.2	19.—	22.6	20.8	21.2	—	dry-matter
	—	0.60	0.66	0.50	0.76	0.77	0.99	sugar

Note: a) The examinations were not performed because of a technical error

from the results of examinations of the average sugar content. We could not succeed in proving our supposition based on the works of HOPE *et al.* (1960) that sugar content increased in the plots de-stemmed at an early date (Table 6).

4. Storage

We have stored from the first gathering date (July 28), the yields of the different plots in forcing boxes covered with an 80 cm. layer of straw, then from the middle of October the yield was placed in an underground storage cellar. The high temperatures of July and August did not result in any physiological degeneration of the stored potatoes and in this respect it was impossible to state the differences between the yields of early gathered and control plots.

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THE TRACE ELEMENT CONDITIONS OF SOME MOOR AREAS IN HUNGARY

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The total and mobile trace element contents of Hungarian peat soils were examined. Investigations extended to the determination of Mn, Cu, Zn and Mo as well as of exchangeable Mg content. It has been established that the exchangeable Mg content of Hungarian peat soils is high so that they presumably do not require Mg fertilization. The total Mn content of Hungarian peat soils is medium but the mobile Mn content is low so that Mn fertilizer application on these soils is justified. Total Cu content of the moor soils is low while mobile Cu content insignificant so that Cu fertilizer application on these soils is necessary. The Zn content of our peat soils is adequate so that in our opinion they do not require Zn fertilizer application. Mo content of peat soils in Hungary is high which manifests itself also in the high Mo content of moor hay. Upon the effect of the high Mo content Mo toxicity develops in cattle which, on account of the low Cu content, still increases. According to our investigations irrigation had no impact on the mobile trace element content of soils.

Introduction

The trace element conditions of moor soils in Hungary are insufficiently studied. We hardly dispose of data in connection with the trace element contents of these soils. Therefore it seemed suitable for the purpose in view to measure the trace element supplies of peat soils in Hungary and to determine what amount of mobile trace element content they dispose of. On the basis of these data recommendations should be made in connection with the application of trace element fertilizers.

In Hungary the high-moor or sphagnum peats are of minor significance, because they rarely occur and on account of their extension have no practical importance. A high significance is attached, however, to flat moors which occupy a comparatively larger area (about 100 000 hectare, 1.5—2 per cent of sown area). Their importance in agriculture consists in the fact that they supply a great amount of forage. Moreover, they can be readily used in horticulture and in supplying mineral soils with organic matter.

It is particularly important to know the mineral matter content of the peat soils and in the first place their trace element content, to be able to increase the biological value of plants grown on moors or to complete it. Besides, we wanted to obtain an answer to the question whether the disease occurring in animals fed on moor hay was in connection with the mineral content of hay or peat soil, respectively.

It is a well-known fact that peat soils are poor in minerals and consequently their trace element content is low, too. Mineral matter content of high-moor peats is the lowest, that of flat moors is somewhat higher and so is their trace element content. This is, however, still considerably less than the trace element content of mineral soils. From the viewpoint of trace element contents a distinction must be made between total and mobile trace element nutrients of the soil.

Relationship of total trace element content of peat soils with geological factors was examined in detail by SALMI (1963) who established that lowest trace element content was found in *Sphagnum* and highest in *Carex* peats. A high Mo content was found by this author in the Finnish moor soils examined which, in his opinion, is connected with the high Mo content of fundamental rock.

High amounts of Mo were found in the peat soils also by PEIVE (1960) and several other authors. From the viewpoint of the supply of plants with trace element nutrients not the total but the mobile trace element contents of the soil are of primary importance.

According to the data of SILLANPÄÄ (1962) the mobile Mn content of organic (peat) soils is a multiple of that of the mineral soils.

According to the data of SCHACHTSCHABEL (1955) the soils below a 15 ppm Mn content are poorly provided with Mn.

LUNDBLAD (1956) in the investigation of moors in Sweden established that on these soils the Cu content was not sufficient for the crops. In his opinion, however, the Cu deficiency cannot be ascribed to the formation of insoluble Cu-humus compounds. The latter process cannot be demonstrated in the soils examined although frequently assumed by several authors.

The investigations of SCHARRER—SCHAUMLÖFFEL (1960) also verify this opinion. They found that Cu fertilizer given in small amounts was more readily available for the plants in the case of peat soils abundant in organic matters than in mineral soils.

IVANOVA (1959) established that the mobility of Mo in the soil was greatly influenced by the active Ca and β-humate content of the soil. Both are found in greater amounts in flat moor peats where as a result the mobility of Mo substantially increases.

ROMANIN (1961) found higher amounts of Mo in peat moor soils (4.0 ppm total and 0.8 ppm soluble Mo). This is a higher value than the Mo content of the Hungarian mineral soils examined by GYŐRI (1962).

To the state of supply by trace nutrients of the crops it can also be concluded from the fact that the trace element content of wild plants on peat soil is identical or lower than in plants grown on mineral soils. In Hungary TÖLGYESI (1962, 1965) examined the trace element content of wild plants and found the Mn and Cu content of *Dactylis glomerata* L. and *Arrhenaterum elatius*

(L) I. et C. Prese on peat soils were substantially lower than that of plants grown on mineral soils. Zn content of the plants is identical while Mo content is fivefold and in the case of *Lotus corniculatus* L. eightfold as compared with that of plants grown on mineral soil. According to the author the disease in the cattle fed on hay from the moors can be explained with the toxic effect of Mo. The Mo content of the moor hay is high while the Cu content is exceedingly low. Thus the Cu to Mo ratio of the hay is not satisfactory

TÓTH (1962) in his fertilizer application experiments conducted on flat moor established that Cu fertilizer application had in all cases a positive effect. Mn fertilizer on the other hand was not effective in Sudan grass while it showed positive effect in potato and sugarbeet. The above works indicate that the trace element conditions of Hungarian peat soils are not satisfactory.

Material and Method

For the purposes of examination samples were taken in nine different places from our moors of greater extent. These samples represent about 70 per cent of the Hungarian moor area. Moreover, we examined in detail the trace element conditions of the moor in the environment of *Keszthely (Úsztatómajor*, six samples).

Sampling was conducted by having proceeded saw-tooth like on the given moor area and mixed the point samples taken from 6—8 places from a depth of 0—20 cm; the average sample thus obtained was analysed in two replications.

The average samples of *Úsztatómajor* (Table 3) were obtained by mixing 10—12 point samples from a depth of 0—10 cm; these were analysed in two replications.

Total trace element content of samples after the burning, and acid digestion was examined and likewise mobile trace element content. Extraction of the mobile trace element content from the soil was conducted with the following solvents:

Element	Solvent
Mg	0.025 n $CaCl_2$
Mn	0.5 n $MgSO_4$ + 0.2% Na_2SO_3
Cu	30 ml cc HNO_3/litre (fs = 1.39)
Zn	1.0 n KCl
Mo	5% NH_4OH

Soil to solvent ratio was 1 : 10 and shaking period 1 hour in every case.

In the extract solution elements were determined with the colorimetric method (GYŐRI 1961). Results of examinations were given for a substance dried at 105° C.

Results and Discussion

Table 1 presents the total trace element contents of the peat soils examined. When comparing these data with those of various mineral soils it appears that total Mn content in the peat soils is only 10 per cent of the total manganese content of mineral soils, while Cu content is about 20 per cent. Total Zn content of the soils examined is about identical with the total Zn content of Hungarian mineral soils. Total Mo content of our peat soils is higher than that

Table 1

Total trace element content of Hungarian peat soils
(calculated for matter dried at 105 °C)

Number of sample	Station	Ignition losses % (500 °C)	Mn	Cu	Zn	Mo
			ppm			
1	*Balatonederics*	41.3	188.7	4.20	35.0	3.16
2	*Mihályháza*.....	48.6	159.0	3.98	134.4	2.24
3	*Hanságfalva*	61.8	84.2	4.79	115.4	4.35
4	*Sármellék*	74.5	80.2	5.55	120.5	4.37
5	*Zalaapáti*	64.5	129.7	4.24	129.7	2.78
6	*Vindornyaszőlős*	62.1	294.2	4.60	110.0	2.32
7	*Ordacsehi*	54.8	74.4	4.96	142.0	2.07
8	*Kecel*.....	51.6	63.5	5.24	98.0	2.49
9	*Úsztatómajor*	61.0	173.1	3.72	59.9	1.68

of the Hungarian mineral soils. Table 4 presents the mobile trace element content of peat soils in per cent of total trace element content.

Magnesium. From the Tables it appears that exchangeable Mg content of peat soils is very high, thus the supply of these soils with Mg is presumably assured. The high exchangeable Mg content is explained by the fact that these soils develop from substances of vegetable origin. Green plants require, for the construction of their chlorophyll content, great amounts of magnesium.

As a result of the mineralization of plant parts this Mg is released and is bound in exchangeable form in the soil.

Manganese. The active manganese content of peat soils consists of water-soluble Mn form, being exchangeable and readily reducible. Taking into account that the pH value of the soils examined is above 7 they do not contain water-soluble form of Mn. The active Mn content consists exclusively of exchangeable and easily reducible forms. The data seem to prove that the active Mn content of our peat soils is very low. From Table 4 it appears that only 0.6—6.7 per cent of total Mn content is in mobile condition. Thus an important part of the total Mn content is bound to organic matter, probably in the form of organic complex compound since it can not be conveyed into solution either by exchange or by reduction. The low active manganese content seems to be in contrast with SILLANPÄÄ's data (1962) who found that the soluble Mn content of the organic soils was a multiple of that of the mineral soils. The contradiction can be explained by the fact that this author has examined high-moor soils the pH of which is low. The pH of the Hungarian peat soils examined is above 7.0 so it follows that in these soils the mobility of manganese is substantially lower. Therefore, the statement of this author according to which the Mn deficiency

in peat soils arises not as a result of bad solubility but on account of the low value of total trace element content is not valid for our peat soils. The total Mn content of our peat soils is comparatively high but the mobile manganese content exceedingly low and therefore, Mn fertilizer application, according to the data of SCHACHTSCHABEL (1955) is justified as these soils belong to the category provided very poorly with Mn.

The Mn content of the wild plants on peat soils is lower than in mineral soils (TÖLGYESI 1965). This also verifies that the Mn supply of plants is not satisfactory. Mn fertilizing of potato and sugarbeet on peat soils resulted in a significant increase of yield (TÓTH 1962). This justifies the application of Mn fertilizer.

Copper. It is a well-known fact that peat soils generally contain little copper. The copper content of the peat soils depends first of all on the amount of mineral constituents. The data of Table 2 verify that the mobile copper content of our peat soils is low, so copper fertilizer application on these soils is certainly justified. In the Table 3 the mobile copper content of the sample from *Úsztatómajor* is, on the other hand, rather high. This is indicated also by the data of Table 4 showing that while in other soils 3—21 per cent of the total Cu content is mobile, in the samples from Úsztatómajor 35 per cent of the total Cu content is in mobile form. To be this higher mobile content in a readily available form for plants is verified by the investigations of TÖLGYESI (1965). The Cu-content of the plants grown on the above soil substantially surpasses the Cu content of plants originating from other mineral areas. The explanation of the high Cu content is that the area examined has obtained about 10 kg/ha Cu SO_4. Since a meadow is involved, the depth of incorporation after the Cu

Table 2

Mobile trace element content of Hungarian peat soils
(calculated for matter dried at 105 °C)

Number of sample	Station	pH		Mg mg/100	Mn	Cu	Zn	Mo
		KCl	H_2O		ppm			
1	*Balatonederics*	7.8	8.0	30.0	4.6	0.17	1.9	0.62
2	*Mihályháza*.....	7.6	7.9	21.0	1.0	0.87	2.2	0.42
3	*Hanságfalva*	7.0	7.3	27.0	3.0	0.98	1.43	0.46
4	*Sármellék*	7.0	7.7	24.0	5.4	0.69	1.03	0.52
5	*Zalaapáti*	7.3	7.5	24.0	2.4	0.41	0.83	0.50
6	*Vindornyaszőlős*	7.5	7.7	18.0	2.6	0.79	0.46	0.45
7	*Ordacsehi*	7.9	8.0	36.0	1.1	0.17	0.53	0.37
8	*Kecel*	7.7	8.0	21.0	1.1	0.75	1.0	0.38
9	*Úsztatómajor*	7.3	7.6	36.2	2.1	0.28	1.28	—

Table 3

Mobile trace element content of peat soil in the environment of Keszthely (Úsztatómajor) (calculated for matter dried at 105 °C)

Sample	Treatment	pH H_2O	Mg mg/100	Mn	Cu	Zn	Mo
				ppm			
1	Primeval meadow non irrigated	7.23	44.5	6.8	1.52	2.4	0.28
2	Primeval meadow irrigated	7.10	53.0	7.3	1.17	2.4	0.35
3	Primeval meadow non irrigated	7.10	48.0	6.3	1.24	3.0	0.29
4	Primeval meadow irrigated	7.10	40.0	6.5	1.34	0.9	0.25
5	Artificial meadow non irrigated	7.23	55.0	5.8	1.18	1.5	0.24
6	Artificial meadow irrigated	7.10	45.0	6.0	1.19	1.0	0.40

fertilizer application is insignificant, so the above amount of Cu is found in the upper few cm layer.

The high mobile Cu content corroborates the observations (LUNDBLAD 1956, SCHARRER 1960) according to which the Cu ions in the peat soils are not bound so strongly and do not become unavailable as it was assumed earlier. Also the Cu fertilizer experiments verified that on these peat soils Cu fertilization had been in every case of positive impact, thus the effectiveness of the Cu fertilizers is of adequate value (TÓTH 1962).

Zinc. According to the data of Table 2 the exchangeable Zn content of our peat soils is low. From Table 4 it appears that only 0.4—5.5 per cent of the total Zn content is found in exchangeable form. The exchangeable Zn content

Table 4

Mobile trace element content of the peat soils examined in per cent of total trace element content

Number of sample	Station	Mn	Cu	Zu	Mo
1	*Balatonederics*	2.4	4	5.5	20
2	*Mihályháza*.....	0.6	21	1.6	19
3	*Hanságfalva*	3.6	20	1.2	11
4	*Sármellék*	6.7	12	0.8	12
5	*Zalaapáti*	1.9	10	0.6	18
6	*Vindornyaszőlős*	0.9	17	0.4	19
7	*Ordacsehi*	1.5	3	0.4	18
8	*Kecel*	1.7	14	1.0	15
9	*Úsztatómajor*	3.5	35	3.4	18

is highest in the samples from *Úsztatómajor*. It is known from model experiments that solubility of Zn compounds is lowest at pH 7.6 (JURINAK—THORNE 1955). The low soluble Zn content can be presumably explained with the moderately basic pH value of these soils. On the strength of the high total Zn content of our peat soils it can be established that these soils dispose of a sufficient Zn content. It seems that we must not reckon with Zn deficiency even on account of the low exchangeable Zn content, since on the peat soils referred to the Zn content of the plants, according to examinations, is in good agreement with the Zn content of plants of other, mineral areas.

Molybdene. The mobile Mo content of Hungarian peat soils ranges from 0.24 to 0.62 ppm. This is substantially higher than the mobile Mo content of our mineral soils. It is well known that mobility of Mo increases with the growing pH value of the soil.

Thus the high Mo content is in close relationship with the high pH value of our peat soils. From the higher mobile Mo content higher amounts are taken up by the plants. Injurious effect of higher amounts of Mo is observed in animals fed on the hay from moors (TÖLGYESI 1965).

While from the aspect of plants the high Mo content does not injuriously affect their metabolic processes, the herbivorous animals are exposed to the toxic effect of Mo. As a result, Mo toxicosis develops accompanied by serious diarrhoea, reduction of performance and deterioration of the animals and can possibly result in their death. In animals fed exclusively on hay of the moors this disease occurs also in Hungary (TÖLGYESI 1965). Mo accumulation can be intensive in wild plants, as referred to in the survey of literature. On the basis of examinations conducted hitherto it can be established that the disease and reduced performance of the animals fed on hay of the moors arises as a consequence of the high Mo content of hay on account of the toxic effect of Mo (TÖLGYESI 1965). Mo toxicity can be reduced in two ways. On the one hand by the increase of Cu content, because Cu is the antagonist of Mo and thus reduces the toxic effect of the latter. On the other hand by feeding the animals not exclusively on hay of the moors but also with fodders from mineral soils. According to our investigations (Table 3) irrigation had no demonstrable effect on the mobile trace element content of the soil.

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TEST ON TERPENOIDS PRESENT IN PARTS OF CORIANDRUM SATIVUM L.

I. THIN-LAYER CHROMATOGRAPHIC EXAMINATION OF THE VOLATILE OIL OF THE PERICARPIUM AND SEEDLING OF THE "LUCS" VARIETY

By

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We made a thin-layer chromatographic study of the volatile oil gained by steam distillation from the seedling of the "Lucs" variety of *Coriandrum sativum* L. and also from the pericarpium after germination. We have come to the conclusion that the volatile oil of the seedling does not contain linalool while the linalool content of the pericarpium remains unchanged even after germination.

Introduction

The fruit of the ripe coriander is a diachaenium which under slight pressure easely splits into two parts. The wall of these parts by the carpophore towards the mesocarpium contains a parenchima with a thicker wall and in it are two volatile oil canals approximately 300—400 μ in diameter *(V. Pharmacopoea Hungarica 1954)*. One of the main characteristics of the volatile oil produced from the Coriander fruit by steam distillation is that, in every instance, 60 or 70% of it is composed of linalool (Gildemeister, 1961). This unsatureted alcohol is mainly used for parfumes, cosmetics and soap producing (Guenther 1950).

In coriander the composition of the volatile oil changes during ontogenesis. This has been proved by the experiments of several researchers (Schimmel *et al.* 1895, Kopp 1928, Tshernuchin 1925, Lőrincz—Tyihák 1965). The components of volatile oil were examined in the plant parts of green coriander at various stages of growth and it has been demonstrated that the volatile oil obtained from the green parts of the plant is entirely different in composition from that one of the ripe fruit. The largest amount of linalool has been demonstrated in the ripe fruit. Lőrincz—Tyihák (1965) examined the changes of the terpene components of coriander in the course of ontogenesis. They proved that traces of linalool could be found at germination and the two-leaves stage while none at the other phases. This compound can again be traced when the green fruit are formed in the main umbell. According to Lukyanov—Mukhanova (1964) two types of oil canals are formed in the fruit: one is the peripheral which vanishes when the fruit is ripe, drying up, while the other remains. According

to the data of HOTIN (1957) if the fruit ripens at a higher humidity, the peripheral canals remain and the quantity of oil increased but the quality is poorer.

In the ripe fruit volatile oil is contained by the internal canals. TANASHENKO (1960) claims that two different kinds of volatile oils are formed in the two different canals. The peripheral ones contain oxidized compounds while mainly alcohols and terpenes are formed in the inner ones. According to the study of LUKYANOV and his collaborator the accumulation of linalool is completed by the ripening of fruit and from then on it does not change.

In our work we have studied the development of volatile oil canals of the "Lucs" coriander from the viewpoint of histogeny and in consideration of its possible relation to the changes of composition of volatile oil. In this present paper one of the detailed results is related.

Material and Methods

The "Lucs" coriander variety which has a very high volatile oil content has been examined. The seeds were germinated at the *Budakalász* Experimental Station of the Scientific Research Institute for Medicinal Plants *(Budapest)* partly in wet sand in greenhouses. The small plants were rinsed in water, dried with filter paper and then ground to a pulp in a mortar with powdered glass. This was then distilled in a glass distillation apparatus based on Clevenger's principe and proposed by the I. S. O. (1962).

As controls we have examined the volatile oil of the dry fruit ground to wire-mesh sieves IV. (V. Pharmacopoea Hungarica standard). The distilled volatile oil was further examined by thin-layer chromatograph which was done in two ways: A) using the LŐRINCZ—TYIHÁK (1965) method and B) according to LASSÁNYI (1965).

A) The quantity taken of the volatile oil diluted with benzene was transferred on the layer prepared in the usual way (STAHL 1962). Adsorbant: Kieselgel G (Merck), solvent: benzene-ethylacetate (98 : 2). Plating distance: 16 cm. Spray reagent: 1% vanillin in concentrated sulphuric acid. After spraying the sheets were dried for 10 minutes at 105° C. After drying the linalool spot appears in violet.

B) Layer preparation in the usual way (STAHL 1962). Activation: at 100° C for half an hour. After cooling the solution diluted with benzene was dripped with a certified pipette of 0.1 ml. Drops of oil solution of identical concentration were applied to each sheet while from the linalool solution drops were increasing concentration. Solvent: benzene. Distance of front: 10 cm. After the evaporation of benzene the sheets were placed in a developing chamber filled with bromide fumes, and after 3—4 minutes of bromizing they were placed under a heat radiator for 15—20 minutes in such a way that the distance from the radiator was approximately 10 cm. A wire screen was placed under the sheets in order to prevent cracking. Round, brown spots began to appear after 5 minutes under the radiator. These spots are proportional to the linalool concentration of the linalool content of the solution is between 60 and 190 micrograms. At such concentration only the linalool spot is visible whereas at greater concentrations the spots of other components also appear.

A transparent plastic pattern with holes of different diameters was used to assay the sheet transilluminated from below. The results obtained were illustrated graphically so that on the X axis we find the concentration and on the Y axis the values of the linalool solution obtained with the pattern method. From this we concluded the linalool content of the volatile oil.

For the histological analysis we kept the material in a 2% aqueous solution of potassium bichromate (MOENIKES 1924) before preparing the epithelial cells and the volatile oil canals. This solidifies the volatile oil and prevents its flowing out during the preparation.

Results and Discussion

At the first collecting, when the cotyledons were in bent state, it was possible to find traces of linalool in the field plants, but when cotyledons opened, no more possible. This fact suggested the idea that the small amount of pericarpium remaining in the sample might influence the results. We should like to add that we used 25 or 32 gramms of wet material, respectively of the field plants for the distillation. This means quite a number of plants for the seedlings of the coriander are very small (10 = 0.20 gramms). For the further histological analyses the material was put into a solution of potassium bichro-

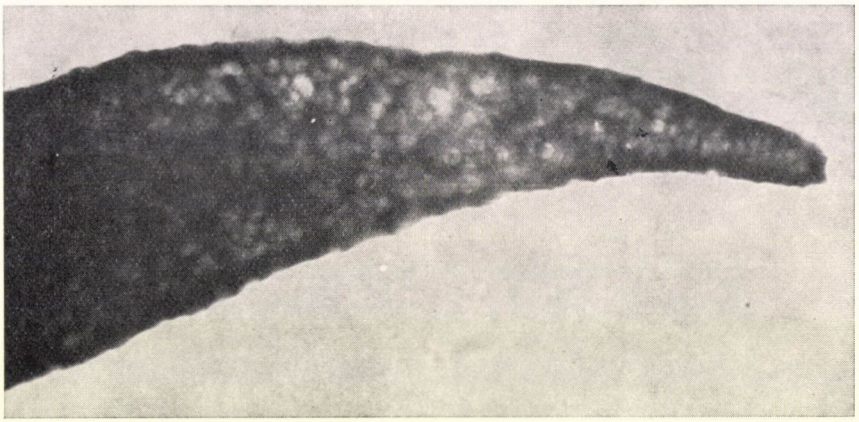

Fig. 1. Prepared oil canal epithelial cells with solidified volatile oil (detail) (100 × magnification)

mate for a week so to make the volatile oil stiff which prevented its flowing out during the section. We succeeded in preparing the oil together with the secretory epithelial cells from the empty fruit (Fig. 1) following the germination. For this reason we are almost certain that the positive linalool reaction obtained in the first collection was due to the small amount of pericarpium which got into the sample. In order to decide this question we again germinated coriander in sand. We separately gathered the empty pericarpia and the small plants and distilled the oil from them. As controls we examined the dormant fruit and then the oil was studied by thinlayer chromatography.

The qualitative examination showed that the young plant contained no linalool (Fig. 2) while the empty pericarpium did. In the oil of the young plants we found two components with the use of method A (number 2). The lower is blue with a somewhat smaller Rf value than the linalool (number 1) which becomes manifest in a violet colour and above it there is a large brownish-grey spot. On the other hand it is clearly visible that the main component of the oil of the exocarpium (number 3) and of the dormant fruit (number 4) is linalool. This

assumption is proved by the results of method B. On the chromatogram obtained by method A the blue component manifested in the oil of seedling and being of lower Rf value than the standard linalool cannot come from concentration differences: it does not occur in the seedling with method B while in the

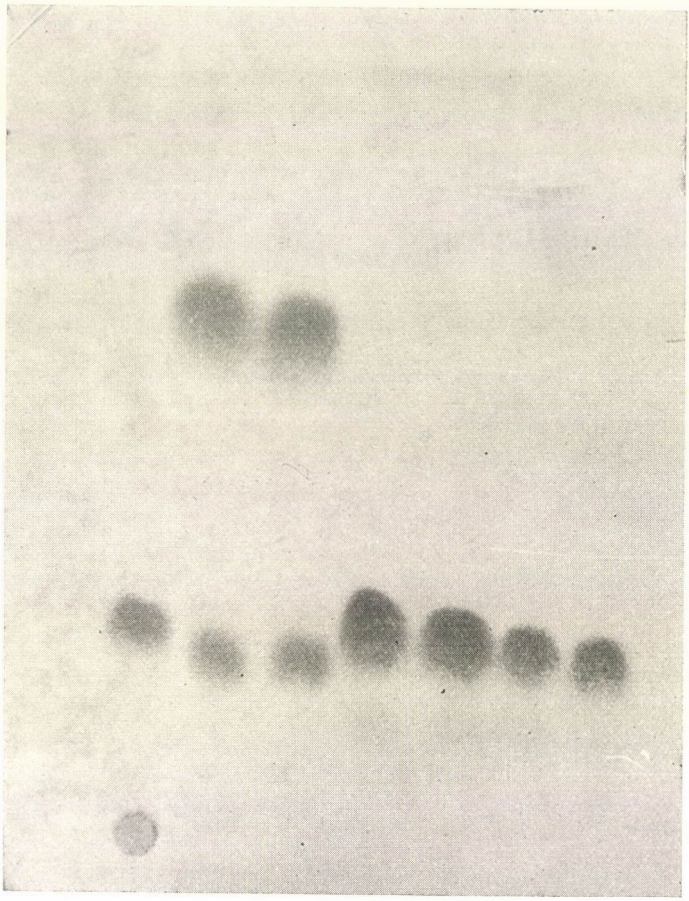

Fig. 2. Thin-layer chromatogram. 1. standard linalool, 2. oil of seedling, 3. oil of the pericarpium after germination, 4. oil of the dried fruit.

chromatogram of the oil of the pericarpium the brown colored spot of linalool becomes visible. Half quantitatively, the oil contained 72.5% linalool in the dormant fruit according to method B, while the empty pericarpium contained 78.0%. Considering the exactitude of method, the two values can be practically regarded as identical.

Conclusion

Similarly to data in literature, our studies show that the volatile oil of seedling differs from the oil of the fruit: the former does not contain linalool. We have stated that the linalool content of the oil of fruit does not change during germination and does not even become used up.

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SOWING TIME VARIATIONS IN BARLEY VARIETIES

By

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In the years 1962, 1963 and 1965 developments of the grain yield and most important traits of seven barley varieties were investigated with a weekly sowing technique. The yields and the scores of the features generally diminished parallel with later seeding. Varieties responded differently to environmental changes originating from seeding date. According to seeding date, year and varieties different yield components or traits were of decisive importance. On the average the number of shoots per plants, ears and main ears changed strongly, while thousand grain weight, ear length and culm height did to a lesser extent. The data obtained can be well utilized for the characterization of varieties.

Introduction

The traits, yield components and yield of barley and other cereals are in very close connection with the environmental factors. Out of cultural practices with the choice of seeding date highly different conditions can be warranted to the plants. The old experience i.e. with earlier seeding higher yields can be obtained, may be considered as almost of universal validity in the case of summer cereals. ZARUBAYLO—KISLYUK (1951) and ZAHAROVA (1960) observed that in barley often higher yield could be traced back to lower temperature and more intensive growth secured by earlier seeding. On the other hand SELIVANOVA (1958) and DONTSEV (1961) reported that earlier seeding of winter barley had resulted in higher damages by flies. ZABLUDA (1954) in his experiments established that with optimum seeding date not only a better and safer yield could be obtained but also a more viable seed of favourable properties in many respects. With an optimum seeding date LARSSON (1961) obtained more intensive tillering and SOWINSKI (1963) a grain yield of lower protein content and higher enzymatic power, i.e. of better quality. On account of the manifold advantages of optimum seeding date it is easy to understand that in order to determine the same several workers KLITSCH (1955, 1955/1), WUTH (1958), FOLTYN (1959), KRESS (1960), SAVITCKY (1961), PETROV (1962), etc. launched several year's experiments with the delayed sowing technique. On the basis of such experiments FOLTYN (1960) taking into consideration daily mean temperature and height a. s. l. evolved a formula to calculate the optimum seeding date of barley.

It is a well-known fact that the seeding date by the changed environmental conditions influences growth and development. Therefore a number of experiments were established concerning the effect of various experimental conditions on development: KUPERMAN (1951), ROSTOVTSEVA (1951), KAMEL (1959), FÜREDI (1959), SKAZKIN (1960), etc. and on growth: ASPINALL—PALEG (1944), KUPERMAN (1951), GRIGORYEVA (1953) DOWNS—PIRINGER—WIEBE (1959).

In our earlier experiments (POLLHAMER 1955) the developments of the value standards of eight winter wheat varieties had been examined as a function of seeding date. According to our experience with this method not only the optimum seeding date can be established but the varieties examined can be more thoroughly get acquainted with by the development of their most important features in connection with the different environment.

Material and Method

Experiments were launched in the Agricultural Research Institute of the Hungarian Academy of Sciences at Martonvásár in 1962, 1963 and 1965 with seven barley varieties (*MFB 104*, *MFB 102*, *Martonvásári Korai*, *Béta 40*, *MK 42*, *r 317/4*, *r 317/5*) on plots seeded manually and with machine. Plot size was with broadcasting 2.1 sq-m (15 × 5 cm spacing) and with machine-seeding 28.77 sq.m. The first sowings started by April 13, in 1962, April 20, in 1963 and March 18, in 1965 and continued weekly. The action of different environment based on later seeding date was characterized with the grain yield and with the change in the scores of some traits. Measurements were carried out on 100 plants of each broadcast plot and the following features examined: *a)* number of shoots/plant, units, *b)* culm height cm, *c)* thousand grain weight, *d)* ear/plant, units, *e)* ear weight g, *f)* number of main ears/plant, units, *g)* ear length, cm, *h)* grain/ear, units. The changes of the features have been represented graphically and for easier survey every year in the case of the first and the last seeding date.

Experiments were established in the barley breeding garden, on a calcareous grassland loam in all three years. Preceding crop was maize to which fertilizer had been applied. Before seeding 150 kg superphosphate, 50 kg Pétisó (calcium carbonate-ammonium nitrate fertilizer manufactured in Pét, Hungary) and 80 kg potassium salt per cad. hold (1 cadastral hold = 0.57 ha) had been incorporated into the soil. Climatic conditions are characterized with the data of the Martonvásár Observatory of the National Meteorological Institute (Table 1).

Results and Discussion

On the effect of gradually later seeding in all three experimental years the length of the vegetation period substantially changed. In the first experimental year in every variety the periods from emergence to earing and from earing to maturation diminished under the influence of later seeding as compared to the first seeding date. Total vegetation period developed accordingly (Table 2). Total vegetation period calculated as varietal mean diminished by about as many days as seeding was later. It is decisive for the yield that under the influence of gradually later seeding the portion of the vegetation period between earing and ripening diminishes first of all in percentual value although this is the shortest as expressed in days.

In the second experimental year first seeding took place April 20th. The plants of the fourth and fifth seeding were destroyed by drought and high mildew incidence already before the emergence of the ears. The later seedings as compared with the first one did not cause shortening in the vegetation period or the changes observed were not significant (Table 3).

In 1965 the first seeding was carried out on 18th March. On the action of the later seedings as compared with this first one the total vegetation period and the period between emergence and earing grew shorter but the period between earing and ripening longer. To the change of environment based on gradually later seeding the varieties responded with the elongation of the portion of the vegetation period between earing and maturation and with the increase of the scores of yield components developing at that time. It is characteristic that within the comparatively lesser change of total vegetation time the change with opposite sign of the single periods was more important (Table 4).

As to the length of the vegetation period of the varieties examined and to its response connected with later seeding there are only minor differences. At any rate the barley variety *Martonvásári Korai* distinguishes itself, which owing to its shorter vegetation period stood the later seeding comparatively well. Its growing period did not change but in quality since the period between earing and maturation lengthened. Thus earliness can be up to a certain point the basis of yield safety although shorter vegetation period is mostly accompanied by lower productivity. In the case of early seeding longest is as a rule the period from sowing to earing, but also lengthening of the period from earing to ripening may occur.

On the effect of environmental changes caused by gradually later seeding also the scores of the yield components and other features of the varieties have undergone a substantial change.

In 1962 the plants of the first seeding as a result of after emergence rainy weather raised many shoots, many main ears and developed a dense stand. The month of May was cooler than average which favoured the development of the thousand grain weight characteristic of the variety. At the end of vegetation period the rise in temperature was not too important and in spite of the deficiency of precipitation a good yield could be obtained with a fair medium thousand grain weight. The plants of the later seedings developed in an ever warmer soil and air, to an ever more rapid rhythm. The more and more sunshine and deficiency of precipitation arising at the end of the vegetation period did not favour growth. As a consequence, parallel with later seeding the scores of the properties examined proportionally decreased (Fig. 1) and so did the yield itself.

On the features examined thousand grain weight and grain to ear ratio changed the least upon the environmental effect caused by later seeding. The

Table 1

Averages of the weather factors per

Months Decades		March			April		
		1	2	3	1	2	3
Temperature °C	40 year average	3.7	4.6	7.1	8.4	10.0	11.9
	± difference 1962	— 0.5	— 5.6	— 3.6	0.4	3.2	4.1
	± difference 1963	— 0.9	— 1.6	— 0.9	— 1.1	3.4	3.3
	± difference 1965	— 2.8	2.1	1.4	2.2	— 1.9	— 2.6
Number of sunlit hours	40 year average	34	50	61	59	70	76
	± difference 1962	—12	—28	—27	— 4	—22	28
	± difference 1963	29	—	10	1.4	—	39
	± difference 1965	—11	13	4	3	—48	—15
Precipitation mm	40 year average	15	9	15	15	17	14
	± difference 1962	8	—	2	19	—13	—13
	± difference 1963	— 7	1	— 3	— 7	—11	5
	± difference 1965	8	— 9	— 6	— 7	15	13
Soil temperature at a depth of 5 cm, °C	1962	1.4	0.9	— 0.5	7.2	10.3	13.5
	1963	— 3.2	— 0.8	0.1	4.9	10.4	13.3
	1965	— 0.2	3.5	8.0	8.6	8.7	9.3

Table 2

Developments of the vegetation period in sowing

	Vegetation vegetative period when seeding				
	I.	II.	III.	IV.	V.
1. *Martonvásári FB 104*	69	66	59	51	—
2. ,, *FB 102*	68	65	59	59	—
3. ,, *Korai*	48	48	48	44	—
4. *Beta 40*	69	66	64	57	—
5. *MK 42*	67	65	61	53	—
6. *r 317/4*	66	62	62	58	—
7. *r 317/5*	68	66	64	61	—
Average	65	63	59	54	—
Average shortening of vegetation period days:	—	— 2	— 6	—11	—
Average shortening of vegetation period days %	—	— 3.0	— 9.2	—16.8	—

decades. Martonvásár 1962—65.

May			June			July		
1	2	3	1	2	3	1	2	3
14.2	15.7	17.6	18.6	18.9	19.7	21.3	21.6	21.5
— 0.3	— 0.2	— 1.3	— 5.6	1.7	1.4	— 5.1	— 0.9	1.3
— 0.4	1.1	— 0.6	— 0.3	— 0.7	2.8	0.6	1.1	0.7
— 2.5	0.8	— 2.7	— 1.9	— 1.3	3.0	— 3.1	0.3	— 1.2
73	86	103	97	88	94	100	99	105
20	—25	2	—28	— 9	—15	—23	—17	11
8	— 1	— 7	— 7	— 7	21	7	9	— 8
—	—19	—41	—27	—14	17	— 7	14	— 7
24	18	24	18	26	18	15	17	18
—20	3	—11	— 7	—15	—18	14	— 3	— 13
—19	— 2	— 7	40	— 6	2	3	10	1
—10	—16	34	75	—15	57	13	— 6	11
13.5	14.7	18.7	14.6	19.3	21.4	17.4	20.2	24.2
13.8	14.6	18.3	18.4	18.9	22.7	23.3	22.5	25.9
11.1	14.7	16.6	17.7	17.7	22.2	19.2	20.0	24.4

time variations. Martonvásár, 1962

time									
generative period					Whole vegetation time				
date was									
I.	II.	III.	IV.	V.	I.	II.	III.	IV.	V.
46	42	42	43	—	115	108	101	94	—
45	40	39	32	—	113	105	98	91	—
59	51	43	38	—	107	99	91	82	—
46	41	36	36	—	115	107	100	93	—
45	40	37	37	—	112	105	98	90	—
47	43	37	34	—	113	105	99	92	—
45	40	36	32	—	113	106	100	93	—
48	42	39	37	—	113	105	98	91	—
—	— 6	— 9	—11	—	—	— 8	— 15	—22	—
—	12.4	—19.1	—22.9	—	—	— 7.	— 13.2	—19.4	—

Table 3

Developments of the vegetation period in

	Vegetation time generative period when seeding				
	I.	II.	III.	IV.	V.
1. *Martonvásári FB 104*	52	55	52	—	—
2. „ *FB 102*	51	56	52	—	—
3. „ *Korai*	33	39	36	—	—
4. *Beta 40*	52	57	53	—	—
5. *MK 42*	49	51	51	—	—
6. *r 317/4*	52	51	52	—	—
7. *r 317/5*	53	53	53	—	—
Average	49	52	50	—	—
Average shortening of vegetation period days:	—	+ 3	+ 1	—	—
Average shortening of vegetation period days %	—	+ 6.7	+ 2.0	—	—

Table 4

Developments of the vegetation period in

	Vegetation time vegetative period when seeding				
	I.	II.	III.	IV.	V.
1. *Martonvásári FB 104*	77	71	64	64	62
2. „ *FB 102*	71	67	61	63	61
3. „ *Korai*	57	54	49	45	42
4. *Beta 40*	75	69	71	64	61
5. *MK 42*	75	67	64	63	60
6. *r 317/4*	74	67	71	63	62
7. *r 317/5*	74	67	71	64	61
Average	72	66	64	61	58
Average shortening of vegetation period days:	—	— 6	— 8	—11	—14
Average shortening of vegetation period days %	—	— 8.3	—11.1	—15.2	—19.4

sowing time variations. Martonvásár, 1963

vegetative period, date was					Whole vegetation time				
I.	II.	III.	IV.	V.	I.	II.	III.	IV.	V.
42	41	43	—	—	94	96	95	—	—
42	42	43	—	—	93	98	95	—	—
45	40	42	—	—	78	79	78	—	—
43	41	44	—	—	95	98	97	—	—
41	41	41	—	—	90	92	92	—	—
43	46	44	—	—	95	97	96	—	—
41	43	43	—	—	94	96	96	—	—
42	42	43	—	—	91	94	93	—	—
—	0	+ 1	—	—	—	+ 3	+ 2	—	—
—	0	+ 2.3	—	—	—	+ 3.3	+ 2.2	—	—

sowing time variations. Martonvásár, 1965

generative period, date was					Whole vegetation time				
I.	II.	III.	IV.	V.	I.	II.	III.	IV.	V.
31	34	35	35	32	108	105	99	94	94
31	35	37	30	32	102	102	98	93	93
31	42	43	44	45	88	96	92	89	87
30	34	29	29	31	105	103	100	93	92
29	35	35	29	30	106	102	99	92	90
29	38	29	31	30	105	105	100	94	92
31	37	29	30	32	105	104	100	94	93
31	36	34	32	33	103	102	98	94	91
—	+ 5	+ 3	+ 1	+ 2	—	— 1	— 5	— 9	—12
	+16.2	+ 9.6	+ 3.2	+ 6.4		— 0.9	— 4.8	— 8.7	—11.6

greatest variation was found in the number of shoots, ears and main ears per plant. Stand density of summer barley is a feature developing during a comparatively long time and according to data and in case of late seeding its development, characteristically of the variety is firstly inhibited. Decrease of the grain to ear ratio proved to be medium.

In 1963, on account of the late first seeding, the drought and the mildew incidence the scores of the features were lowest. Environmental change caused by later seeding date considerably diminished also in this year the scores of the features (Fig. 2). In contrast to the experience gained in the previous year,

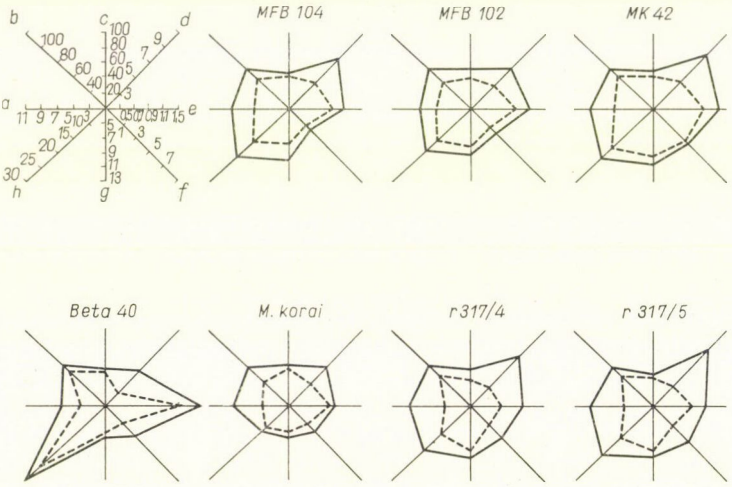

Fig. 1. Developments of features in varieties, Martonvásár 1962. (Earliest seeding 13. April; Latest seeding 11. May)

however, ear weight was the same while thousand grain weight and ear length increased proportionally to later seeding in most varieties. Drought that had lasted almost over the whole vegetation period hindered particularly the growth of the plants of later seeding. Substantial increase of ear length was promoted beside less tillering also by the weather in the months of May-June which being cooler than the average. Increase of thousand grain weight and ear weight was made possible mainly by the precipitation in the first decade of the month of June. The data call the attention to the fact that the weather factor favourable for the development of grain to ear ratio, thousand grain weight and ear weight may diminish, by the increase of these features, the loss of yield. If on the other hand — as in the present case — the grain yield is mostly based on these features, neither the size of the grain yield nor its safety are satisfactory since the yield components developed non characteristically of the variety.

In 1965 owing to the considerable deficiency of precipitation prevailing since the beginning of the year growth has substantially slowed down. In spite

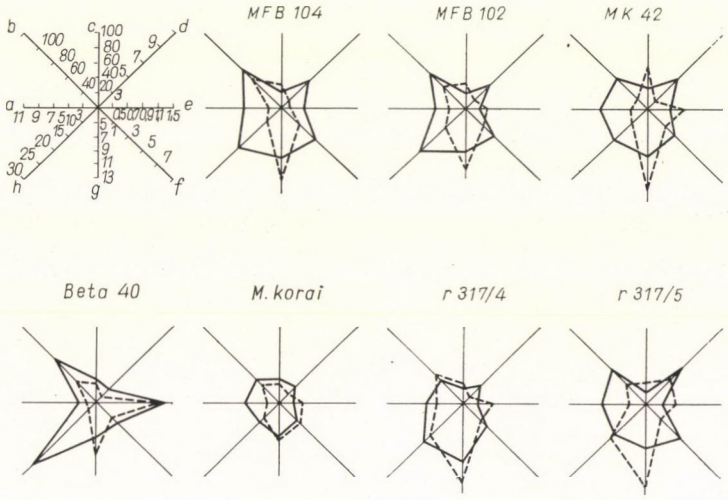

Fig. 2. Developments of features in varieties, Martonvásár 1963. (Earliest seeding 13. April; Latest seeding 11. May)

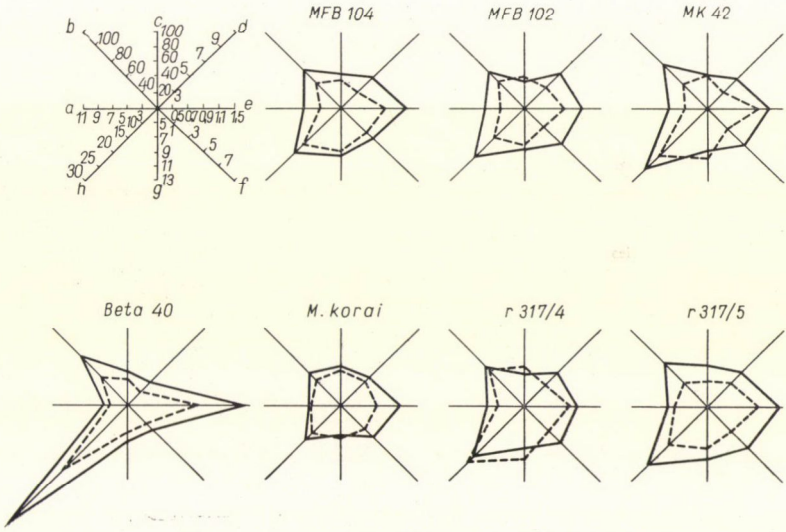

Fig. 3. Developments of features in varieties, Martonvásár 1965. (Earliest seeding 13. April; Latest seeding 11. May)

of the early seeding a lower stand density developed which on the effect of later seedings diminished to a lesser extent than in the two previous years. The plants developed, however, in cooler soil and air and have received from the second decade of April less sunshine than average. These factors promoted the development of the grain to ear ratio so that this feature together with the mean ear weight became a decisive yield component in this year (Fig. 3).

Table 5

Grain yield according to seeding dates q/cad. hold
Martonvásár 1962, 1963, 1965

Year	Seeding date					Average
	I.	II.	III.	IV.	V.	
1962	18.4	17.4	14.0	12.5	—	15.6
1963	12.9	9.6	3.7	—	—	8.7
1965	15.7	18.9	17.3	12.0	8.6	13.3
Average	15.6	15.3	11.6	8.1	2.9	12.5

Grain yield according to seeding date in conformity with the yield components has diminished proportionally to the later seeding (Table 5). The measure of reduction was highest in 1963 because in that year the decrease of all features according to the seeding date was also most important.

The grain yield has changed similarly in the average of the varieties (Table 6). The changes of the grain yield correspond to the changes of the yield components and of the other traits.

Table 6

Grain yield according to varieties q/cad. hold
Martonvásár, 1962, 1963, 1965

Varieties	Years			Average
	1962	1963	1965	
MFB 104	16.0	8.9	14.2	12.8
MFB 102	14.7	9.7	13.4	12.6
M Korai	11.8	6.3	10.1	9.4
Beta 40	16.9	7.6	16.2	13.5
MK 42	19.6	10.8	16.5	15.6
r 317/4	15.4	10.2	11.7	12.4
r 317/5	15.4	8.1	11.0	11.4
Average	15.6	8.7	13.3	12.5

Conclusions

In the Agricultural Research Institute at Martonvásár the changes of the grain yield and of 8 most important features of 7 barley varieties had been examined for 3 years with weekly seeding.

Upon the effect of later seeding the vegetation period became generally considerably shorter and the plants grew more and more under conditions not corresponding to their demands. As a result the scores of the features developing under unfavourable conditions have generally decreased and so has the yield itself after all. From the aspect of the size of yield it is of decisive importance that the later seeding diminishes for the most part the length of the period from earing to ripening although this is the shortest as expressed in days. By early seeding optimum conditions will be prepared first of all for the development of the components of stand density i.e. of the number of shoots per plant, ears and main ears. It may occur, however, that the changed conditions based upon seeding date make it possible not for the higher stand density but for the higher grain to ear ratio to develop.

According to data stand density is the most changing feature while thousand grain weight, ear length and culm height are the least changing ones. It is important to develop a great stand density with early seeding as under the conditions prevailing in Hungary high stand density has been the basis of great yields. On the other hand the experimental data of 1963 and 1965 verify that other yield components may also have a decisive importance.

Maximum grain yield can be obtained if the plants can grow in the whole course of their vegetation period under such conditions that enable for features characteristic of the variety to develop. It is not favourable, therefore, when a yield component is of extremely high value for in such cases the development characteristic of the variety of the other yield components and features is often inhibited. In such instances the biological balance-characteristic of the variety of the yield components and of the other features is upset and in many cases neither the size of the grain yield nor the safety of the yield will be satisfactory.

In the first place the indirect effects of the seeding date are important with the purposeful choice of which the favourable probability of the wheather factors can still be influenced which factors are of decisive importance in the development of the most important features. Temperature of air and soil, amount of precipitation, length and intensity of light are firstly the features that influence the length of the vegetation period, values of features and of the yield.

The yield changes at the varieties are invariably modified according to the weather conditions prevailing at the time when the features examined are developing. Average changes depended to the highest degree on seeding date, to a lesser extent on the year and comparatively to the least extent on variety. The data have verified that the proper seeding date is very important concerning the amount of crop yield.

Delayed sowing technique is very suitable for the investigation of cultural conditions based on seeding date, as well as of relationship between individual features and crop yield and of the characterization of varieties.

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NUTRIENT CONSUMPTION OF THE ALFALFA WEEVIL

[HYPERA (PHYTONOMUS) VARIABILIS HRBST. (COLEOPTERA, CURCULIONIDAE)]

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Measurement results obtained in the course of laboratory nutrient consumption tests conducted with larvae and imagoes of *Hypera variabilis* Hrbst. are discussed. One larva in the course of its development consumed 28.5 mg green lucerne leaves which amounts to the 2.6 fold of the developed live weight of the larva. The larvae increased to the 210 fold (19.5 mg) (L_3) of their initial (L_1) body weight (0.05 mg) and subsequently until pupation have lost 7.6 per cent of their maximum body weight.

One imago consumed from emergence out of the pupa condition until the diapausa 338.6 mg of green leaves. This amount is 33.8 fold of the weight of imago at emergence.

Introduction

In the last decade a new branch was born, in the field of plant protection research i.e. the plant protection management. The introduction of this branch of research work in Hungary is attached to the name of KACSÓ (1958, 1962, 1965). Plant protection management has developed first of all in the socialist countries where farming is conducted on large scale, according to plans. Such farming system is bound to plan also the protection from plant diseases and pests. For the planning as a point of departure concrete biological knowledge is required which means above all that the relationship between the parasite and the cultivated plant serving as nutrient must be explored also from the economic viewpoint. In this relationship it is important to know the so-called number of danger involved, which responds to the question, the presence of how many animals in a given developmental stage of a crop stand, makes protection justified and to what extent.

In an earlier paper (1960) we had already noted — what we wish to stress again — that from biological point of view the determination of the number of danger involved — of whatever aspect this danger should be — (causing total destruction, numerically not determined or numerically determined damage), is a very complicated task. The problem would sooner be approached by many-sided examinations, conducted with various methods than to resolve in an exact way since we are faced by a multitude of influencing factors out of which only a few can be experimentally studied. These factors are, to name only a few important and manifest ones: meteorological conditions (tempera-

ture, precipitation, humidity, direction of wind, photoperiod), development stage of plants, their regenerative capacity, area of cultivation for the endangered crop, vagility and abundance conditions of the damaging population of larvae and imagoes, etc. In our present opinion one of the most important issues is to measure the nutrient comsumption of the feeding developmental forms (imago, larva) during their development and in the same period to do so — several times and depending on plant growth — with the parts of plant serving as feed. Such examinations can only be performed in a laboratory which involves that the values obtained are only of informatory character.

For the establishment of nutrient consumption of some insect species comparatively few data are found in literature. The object of these investigations was more the determination of nutrient consumption during larval development and of rules concerning the utilization of feed. References are found in the study of SÁRINGER (1961). The evaluation of the nutrient consumption for some pests in view of determining the number of danger involved, was only carried out by SÁRINGER (1954, 1960) and JERMY—SÁRINGER (1955).

The question of the number involving danger in plant protection of western countries became topical ever since the concept of integral plant protection has gained ground (STERN—SMITH—BOSCH—HAGEN 1959). The establishment of the number involving danger or, as called by BAGGIOLINI—WILDBOLZ (1965), degree of danger (degré de menace) has come to the front in connection with the animals damaging products for direct consumption (fruit, vegetable) and in order to reduce the protective measures to a minimum.

In the present paper the results of laboratory examinations concerning the nutrient consumption of the larvae and imagoes conducting ripening nutrition of an important pest in lucerne the alfalfa weevil are published. In possession of the data of nutrient consumption we have made an attempt to establish the degree of danger to a given developmental stage of the crop stand. Of course in this relation we can only obtain the degree of danger causing total destruction. These speculative calculations point rather to difficulties of the problem, than offering a particular use practical of aspect.

Material and Method

Imagoes necessary for the experiments, were collected in lucerne stands in the environments of Keszthely, then raised in laboratory and the eggs collected. Larvae used for the weighing were hatched from eggs laid by a female within 24 hours. After hatching they consumed no leaves or only a minimum quantity. The newly hatched larvae were transferred with a fine brush on aqueous hygrostate. The parts of the hygrostate: a glass butter container half filled with water and covered with linnen by the aid of a rubber ring, with filter paper and Petri disk cover. The larvae during the time of the measurements were raised on the same hygrostate.

The lucerne serving as feed (*Medicago sativa* L.) was raised in the breeding garden. Young leaves at the apical part of plant were mostly used as nutrient. At the measurement of feed one leaf found on the leaf stalk was weighed on an analytical balance and used as feed while he op posite leaf also weighed and after 24 hour drying at 105° C repeatedly weighed and used

for the calculation of dry matter per cent. Weighings were carried out every 24 hours and each time the developmental stage of the larvae established by counting the exuvia cast off. At the same time the dead larvae were also counted. The larvae were put into the weighing disk also with the aid of a fine brush. When weighing in the fresh feed what had remained from the previous day was put, after washing off with distilled water, in a test tube and dried for 24 hours at 105° C then weighed again. Washing off with distilled water was necessary to remove the adhering secretion.

The culture was kept in a 28° C thermostat chamber where daily illumination was 15 hour with about 1500 lux light intensity.

Results and Discussion

Of the data obtained in the course of examinations only the most essential part is presented in Table 1. In connection with the data of the Table the following should be noted.

Number and developmental stage of animals were established by counting the exuvia cast off.

In the total weight of larvae and imagoes the weight of all living and dead larvae and imagoes plus larval exuvia are included.

When calculating the weight of one individual only living animals were taken into consideration.

Change, in the weight of an individual, means an increase or reduction of weight as related to that of the previous day.

Fig. 1 presents feed consumption per one larva (C) and imago (D) as well as body weight increase of one larva (A) and imago (B).

The diagram indicating the body weight increase of the larva (A) begins to rise mildly, than after the first shedding of the larvae, suddenly and continuously until the end of nutrition.

The larvae finished their nutrition on 27 July and then spun out of a fine silk thread a cocoon around themselves under the protection of which they transformed into pupae.

The mean weight of a pupa without cocoon was 9.7 mg, together with cocoon almost exactly the same as in the developed larval stage. Thus the alfalfa weevil larvae in contrast to those of the *Tenthredinidae* (SÁRINGER 1957, 1961) after reaching their maximum weight do not substantially loose from their weight.

The diagram indicating the daily feed consumption of a larva (C) runs similarly as that representing the change of body weight. Here, however, some breaks can be observed which is explained by the feed consumption suspended before, during and immediately after casting off.

From the course of the B and D diagrams of Fig. 1 it appears that while the body weight change of imagoes shows after the beginning of nutrition, a rising trend and then after a mild maximum evenly decreases until the diapause sets on, the feed consumption (D) suddenly rises very high first and

Table 1

Numerical data of body weight and feed consumption during larval development and nutrition for maturation of the imago

	Number and developmental stage of animals	Total weight of larvae and imagoes, g	Weight of an individual in g	Change in weight of one individual g	Dry matter per cent of nutritional plant	Total green leaf consumption of larvae and imagoes in g	Green leaf consumption per one larvae and imago in g
20.7.	$15L_1$	0.0009	0.00005		19.4		
21	$15L_2$	0.0008	0.00005	−0.0000	14.6	0.0054	0.0003
22	$7L_3 8L_2$	0.0022	0.00014	+0.00009	17.1	0.0070	0.0004
23	$13L_3 2L_2$			?	15.4	0.0208	0.0013
24	$13L_3$	0.0150	0.0011	+0.0009	20.3	0.0670	0.0051
25	$5L_4 8L_3$	0.0309	0.0023	+0.0012	19.2	0.0571	0.0043
26	$12L_4 1L_3$	0.0722	0.0055	+0.0032	22.9	0.0752	0.0054
27	$13L_4$	0.1372	0.0105	+0.0050	24.2	0.1531	0.0117
							0.0285
3.8.	1 pupa		0.0097				
	1 cocoon		0.0013				
	4 ♀	0.0426	0.0106				
	7 ♂	0.0667	0.0095		19.9	0.2672	0.0222
4	12 imago	0.1230	0.0102		23.8	0.0656	0.0054?
5	12 ,,	0.1318	0.0109	+0.0007	19.3	0.3088	0.0257
7	12 ,,	0.1336	0.0111	+0.0001	16.3	0.2999	0.0249
8	12 ,,	0.1355	0.0112	+0.0001	19.3	0.1721	0.0130
9	12 ,,	0.1347	0.0112	0.0000	16.8	0.1310	0.0108
10	12 ,,	0.1319	0.0109	−0.0003	20.8	0.1321	0.0110
11	12 ,,	0.1340	0.0111	+0.0002	17.8	0.0652	0.0054
14	12 ,,	0.1286	0.0107	−0.0004	20.7	0.0744	0.0062
17	12 ,,	0.1296	0.0108	+0.0001	19.3	0.0835	0.0069
25	12 ,,	0.1230	0.0102	−0.0006	16.7	0.0857	0.0071
							0.1386

subsequently decreases with the same rapidity so as to have a final rise until the end of nutrition, without approximating again the initial level. Thus the nutrition of the imagoes, until the onset of diapausa shows a decreasing trend. The same observation was made by KOEHLER—GYRISKO (1963) in the United States in their examinations with *Hypera postica* Gyll. imagoes.

According to measurements one larva consumed, in the course of development, 28.5 mg green lucerne leaves which is 2.6 fold of the live weight of the developed larva. During the 7 day larval development the larvae have grown

to the 210 fold (10.5 mg) of their initial (L_1) body weight (0.5 mg) (L_3) then until pupation lost 7.6 per cent (0.8 mg) from their maximum body weight.

The weight of green foliage consumed in the individual developmental stages was calculated from the data of Table 1. In the following the amount of green foliage consumption in the individual developmental degrees is presented in per cent of total consumption. Thus one larva has consumed in the L_{1-2} stage 7.02 per cent of the amount of foliage necessary to its development, while in the L_3 stage 32.98 and in L_4 60.00 per cent.

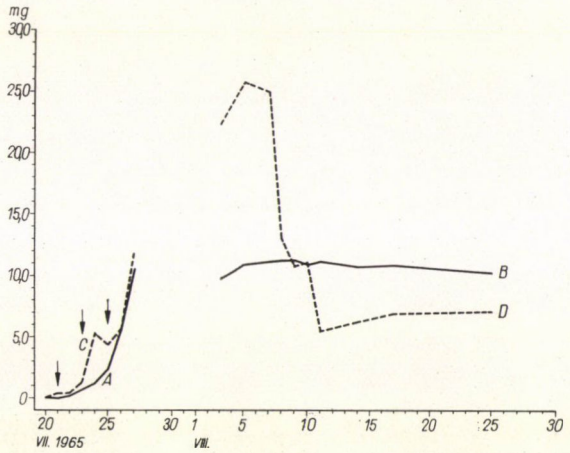

Fig. 1. Daily change of the live weight of a larva (A) and an imago (B), of the green weight of the feed consumed (C larva and D imago) on 28° C and with daily 15 hour of illumination. Horizontal axis: days; vertical axis: weight change in mg. Arrows indicate the dates of casting off

From these data it appears that the larvae consume 92.98 per cent of their total consumption in the third and fourth developmental stage. From the period of larval development 4 days fall to the two last developmental stages. For the period of control these data indicate that larvae should be killed if possible before the onset of intensive nutrition, i.e. shortly after hatching from the eggs to prevent more serious loss of foliage.

According to the data of Table 1 one imago (consumption of males and females was measured together) had consumed 338.6 mg green foliage, from emergence out of pupa until the onset of diapausa which is 33.8 fold of the emergence weight of the imago.

Determination of the degree of danger causing total destruction

Knowing the larva and imago nutrient consumption data obtained in the course of the above investigations we calculated, that the lucerne stand developing outdoors on 1 sq.m., made possible the raising of how many larvae or imagoes, in a given period.

For the basis of calculations we selected, on July 19, in the environments of Keszthely, a lucerne field where on five well established sq.m we counted the number of plants. The height of the plant stand generally reached 34.5 cm. On the average 755.2 plants with stems fell on one sq.m. The weight of all leaves of ten plants with stems — without leaf stalk — was determined on the analytical balance. According to weighings on 1 plant the weight of leaves was 2.6784 g on the average. Calculated from this value there were leaves of a weight of 2022.7 g on the average on a sq.meter at the date of weighing.

This amount of leaves assures the development of 70,972 larvae on a sq.meter and it can afford feed until the diapausa to 5973 imagoes which began nutrition for maturation. When taking as a basis the amount of leaves (0.3671 g) consumed from the hatching until the diapausa after the nutrition for maturation of the imago we obtain the result, that leaves found on a sq.m can afford possibility of nutrition for 550 g animals in the period indicated.

As pointed out in the Introduction these values are of course of highly theoretical character because the individual density of damaging species is never distributed so evenly on a given area as presumed by the above train of thoughts. The practical utility value of calculated data is also reduced by the fact that animals do not consume the main rib of leaf which represents almost the same weight as the other parts of the leaf together. These calculated data thus refer only to the case of relationship between animal and plant when the height of the plant is 34.5 cm and 755.2 plants with them occurs on a sq.m. and further the above population density develops. Such situation, however, in reality hardly occurs.

It may be, however, concluded from the examinations that we must start in this direction if we want to determine the degree of danger in a more exact form. If we are able to determine systematically the weight of leaves from the early spring until late in the autumn and perform the calculations for crop stands of various development, the damage can also be numerically expressed.

Conclusions

According to weighings in laboratory a larva during development consumed 28.5 mg green leaves. The larvae consumed 92.98 per cent of their total consumption in the third and fourth developmental stages. The green foliage consumption of an imago from the hatching out of the pupa until the onset of diapausa was 338.6 mg. Outdoors, in the second half of July, the green lucerne leaves found on a sq.m. assure feed for 70,972 larvae and 5973 imagoes. Thus in a given plant development state this is the value of the degree of danger causing total destruction.

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THE PRODUCTION AND EXPERIMENTAL GROWING OF TRIPLOID WATERMELONS

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Improvement of the triploid (seedless) watermelon was begun is 1959. Approximately 51 tetraploid melons were produced from the colchicine treatment of the *Dew Green*, *Rhode Island Red*, *New Hampshire Midget*, *Asahi* and *Sugar Baby* varieties (seeds were pre-soaked for 24 hours and then put in a 0.5% colchicine solution for 48—52 hours). Tetraploids were crossed with their diploid forms and with other diploids. From this we gained 22.8% triploid seeds but only if the mother was a tetraploid. The results of the 1963 experimental production were not the best, but in 1964 we succeeded in gaining 50% from the sown seeds. In spite of the extremely cool weather of 1965 we also gained good results. The quality of the triploid melons is very good and although their production is very expensive it is worthwhile for export.

Introduction

Already in 1939 INONE had produced tetraploid watermelons in Japan. Then the use of polyploid watermelons for the later production of succulent triploids has not yet been considered. In 1947 KIHARA (1951) produced a tasty triploid watermelon hybrid. Later KOYAMA (1952), FURUSATO (1952a, b), MATSUBAYASI (1954), SADAO (1955), KANAZAWA (1955), KONDO (1955), SAKATO (1955), SHIMOTSUMA (1958, 1959, 1961, 1962) did experiments with triploid watermelons and concluded that the seedless watermelons were in all instances more tasty and aromatic than the diploid melon varieties currently being produced in Japan.

Soon many combinations of triploid heteroses were produced and certain types were capable of satisfying the most particular tastes. On the basis of the Japanese results other countries produced triploid watermelons, too. In the Philippine Islands TORRES (1956), in Italy BIANCHI—MARCHESI (1958, 1959, 1964), in Czechoslovakia VENENI—BARTALOS (1965 in litt.) and in the United States the Burpee Seed Company (1961) began experiments on triploid watermelons.

In Hungary J. KOVÁCS was the first to produce very late, thick-skinned tetraploids which were not suitable for production. In 1957 in *Újmajor* I. FÜLÖP obtained a triploid watermelon from the crossing of tetraploid *Jamato* × *Marsowszky*. In *Kecskemét* the production of seedless watermelons began in the spring of 1959 (KISS 1961a, b). Here from the very beginning we had succeeded

in bringing about such combinations which matched the Japanese hybrids for taste, earliness and size of fruit. On the other hand the production of triploid melons proved difficult because of the cost involved. According to Jasuo Ohta, a geneticist of the Kihara Institute, who visited us in the summer of 1965, seedless watermelons have not become widespread in Japan because of the complicated seed production and the high price of the seeds, however, many companies are working on seed production and many growers are concerned with melon production for the market. In Hungary the price of the triploid melons is

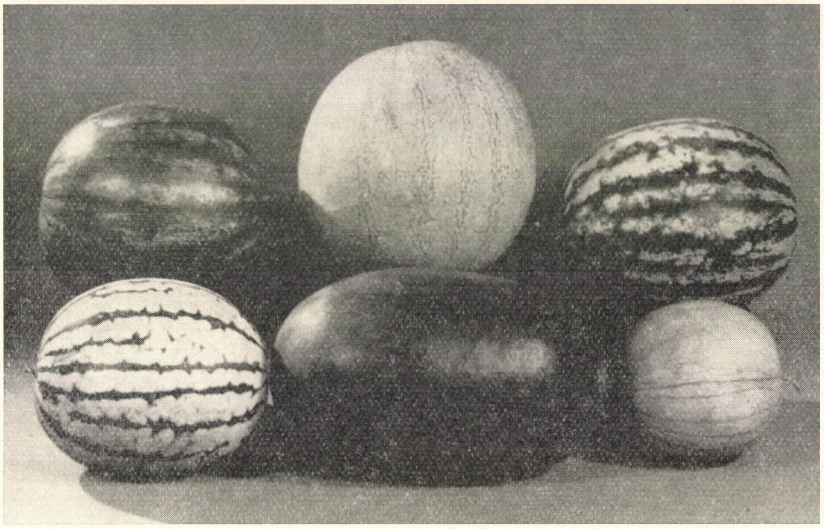

Fig. 1. Upper row: Dew Green, Asahi, Rhode Island Red-1, Lower: Rhode Island Red-2, Klondike No. WR. 65, New Hampshire Midget mother partners (Photo: Tóth)

more than double that of the usual melons and the price of the seeds is more than ten-times as much.

Material and Methods

Since imported triploid seeds are very expensive we have tried to produce such hybrids which could be produced at a reasonable price by the melon growers.

For our purpose we harvested many melon varieties. Since varieties with small fruits are demanded for export (VIGH 1956) we tried to select as parents those which produced melons of 3—5 kg. in weight. Thus we selected *Dew Green*, *Rhode Island Red*, *New Hampshire Midget*, *Asahi* and most recently the *Sugar Baby* variety (Figs. 1, 2).

From the total of 5,600 seeds treated between 1959 and 1963 we produced 51 (0.91%) tetraploid forms. Before treating the seeds had been soaked for 24 hours in water of approximately 36° C, then the split seeds placed for 48—52 hours in a 0.5% colchicine solution. After treatment we washed the seeds under running tap water and planted each in a square of sod. Until the seeds sprouted they had been placed on a tray heated at 28—35° C. Ninety percent of the seeds did not sprout or rather after germination they died before producing the first leaves. We gained tetraploids from 8—10% of the remaining live plants.

Providing we had not had enough seeds from any of the melon varieties we could surely gain polyploid forms by treating the apex of the shoot in the cotyledon stage. Using GYŐRFFY's method (1944—45) a piece of cotton dipped in colchicine was placed at the apex of the shoot and three to four times daily this was moistened with a water solution of colchicine.

Fig. 2. Sugar Baby tetraploid (Photo: Tóth)

Fig. 3. 1. tetraploid seedlings induced with colchicine; 2. untreated control; 3. treated sprout tip; 4. treated seed (Photo: Tóth)

Treatment continued for three days and then the plants went untouched for five to six days. Where the treatment proved effective the appearing leaves were formless, leathery and showed rudimentary growth (Fig. 3). Later development was also slower. The appearing male and female flowers characteristic of the tetraploids were much larger than those of the initial form. The surest results were as well provided by a chromosome count.

Results

After having produced tetraploids in order to produce triploid hybrids, the tetraploid and diploid parents were crossed. Our first triploid crossing (KISS 1961a, b) yielded only 13.4 and 15.3% fruit set. Only 15.7 and 19.0% of the set seeds germinated.

In 1964 12,000 seeds from triploids were planted; of these 7,500 (62.5%) sprouted. During the cultivation of seedlings an additional 1,500 plants died but in spite of this there was still 50% of the sown plant maturing. This was considerably greater than that of the previous year.

In the cool, rainy summer of 1965, 1,400 triploid crossings were made. From this 450 fruits set (32.1%). From the total crossed flowers 321 fruits

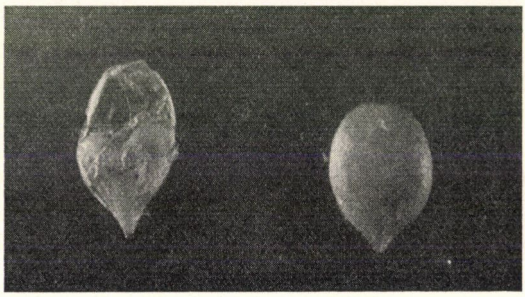

Fig. 4. There is less stored nutrient material in the triploid seed than in that of the diploid (Photo: Tóth)

(22.8%) developed from which we could gain seeds (800 g or approximately 16,000 seeds). The sprouting values will only have been known in May of 1966. Fruit setting was never gained from the reciprocal crossing when the diploid parent was used as mother.

The above results are still unfavourable. If we consider that 15.7 and 19.0%, respectively of the set seeds of the first two years sprouted, then even here we have a slight advance.

In fact the production of triploid watermelon seeds is difficult and expensive. According to our examinations one cadastral "hold" — depending on the weather — can produce 2—4 kg. (40—65%) of hybrid seeds capable of germinating from which, depending on conditions, seedlings sufficient for only 4—10 cadastral "hold" can be produced only by the most expert seedling cultivation. According to our experience, when the temperature of germination does not reach 28—30° C, the germination is unusually low (20—25%) even if the embryo in the seed is good and healthy, i.e. the carpium of the triploid seeds is thick and hard, the germ is stunted and there are little reserve nutrient materials in the cotyledons (Fig. 4).

It is disadvantageous that the crossings can be done in only one direction.

If we could successfully get seeds by reciprocal directions then one fruit would yield an average of 300 seeds, half of which would be capable of germination. Unfortunately seed setting of tetraploids is weak (Average of 20—50 seeds per fruit). Therefore one of our goals for improving is to gain greater seed setting among the tetraploid population and reach at least 50% germination.

Both among the tetraploid and the particular strains there are great differences between the settings of the individuals. While seed setting per fruit among the first year autopolyploids is 5—67, that of the second year tetraploids 28—70. The number of seeds in the tetraploid with the greatest setting is 150.

Owing to the above the current production price of one kilogram of triploid watermelon seed is approximately 8,000 Forints and this produces enough seedlings for two cadastral "holds". However, the triploid watermelon should never be grown by itself because its male flowers are sterile. Therefore when transplanting we must include two rows of pollinating varieties after every four rows. Depending upon conditions there will be a lot of pollen and greater fruit setting. Mixed watermelon fields should contain two-thirds triploid and one-third diploid pollinating varieties. Thus we can depend on 60 quintals of marketable triploid and 30 quintals of diploid fruit. This includes 40 q. of exportable (3—5 kg. in size, well-shaped) first class triploids and 50 q. for the home market (20 q. triploid and 30 q. diploid pollinating varieties). The production of triploid watermelons is profitable only if the grower receives double the standard price for the triploid (seedless) melons. The price is worth it because the growing of triploid melons requires greater expertise, more demanding work and more investment.

In consideration of all these it is questionable whether it is worthwhile to grow this new type of watermelon. As an answer let us turn to the Japanese example. In Japan, too, (SADAO 1955, etc.) the triploid watermelon seeds, being expensive and their germinative ability weak, were received with hesitation. Today the demand for these seeds cannot be satisfied: their popularity is due to their quality.

According to our examinations the greatest advantage of the triploid melon is its unusually good taste and aroma. In judging fruit we have employed a 20-point system. Since we consider the taste of the melon the most important we naturally give it the highest values (1—10) and gradually less for the colour of the flesh (1—4), the shape of the fruit and the fibrousness of the flesh (1—3). The maximum, and best, is 20, while the completely worthless melon deserves a 4. Table 1 shows the analyzed values of a few hybrid combinations compared to the best foreign and domestic varieties.

From the Table it can be seen that the seedless (triploid) watermelons excel in taste and aroma, moreover the *Kecskeméti 09* triploid is equal to the triploid melons of Japan in taste.

Table 1

Results of the watermelon judging

(1960—1963)

Variety (hybrid) (1)	Shape (2)	Fruit		Taste (6)	Total points (7)
		Flesh (3)			
		Colour (4)	Crispness (5)		
Awardable Points	1—3	1—4	1—3	1—10	4—20
Sugar Baby	3.0	2.2	2.2	6.1	13.5 ± 0.35
Marsowszky	2.7	2.6	2.0	6.1	13.4 ± 0.52
K. red fleshed	2.9	3.4	2.4	7.5	16.2 ± 0.42
K. F_1 heterosis	2.9	2.8	2.2	6.9	14.8 ± 0.38
K. triploid 08	2.8	2.5	2.6	7.9	15.8 ± 0.37
K. triploid 09	2.8	2.6	2.8	9.2	17.4 ± 0.40
K. triploid 010	2.7	2.3	2.3	7.6	14.9 ± 0.51
Asahi Japan 3×	3.0	2.8	2.8	7.9	16.5 ± 0.52
Cream Japan 3×	3.0	2.9	3.0	9.4	18.3 ± 0.66
Sunrise Japan 3×	3.0	2.9	3.0	9.3	18.2 ± 0.63

The triploid heterosis surpass the diploids in sugar content. The total sugar content of the diploid parental partners according to VIDÉKI (1965 in litt.) was 6.21—10.1% between 1960 and 1964, while that of the Kecskeméti triploids is between 7.45 and 10.6%. The analysis of the seeds revealed that the seeds of the tetraploids were the largest, those of the diploids and triploids smaller, while the haploid seeds the smallest. While the tetraploid and diploid seeds were always rounded, the majority of the triploid seeds were flattened and indented (Figs. 4 and 5). Triploid seeds can be distinguished by their striking characteristics and we attempted to produce them from free-flowering by bee pollination. In order to achieve this we transplanted tetraploid watermelons with diploid types in a ratio of 2 : 1 or 3 : 1. Such a mixture yielded three types of seed progeny:

1. Varieties produced from pure pollen (the diploid had been pollinated with its own pollen).

2. Tetraploid mother type (pollinated by the pollen of its own polyploid form and thus 40—50% tetraploid seed progeny arise depending on the weather conditions).

3. Triploid forms (c. 50—60%) arising from spontaneous crossings.

It should be noted that tetraploid and triploid seeds may be obtained also from one fruit depending on whether tetraploid or diploid pollen was used for pollination.

In selecting the crossing population the mother and father varieties have to be selected from the beginning in such a way that the triploid hybrids can be surely determined in the F_1. Unfortunately the *Sugar Baby* tetraploid and the *Dew Green* cannot be used for obtaining the unusually tasty triploids be-

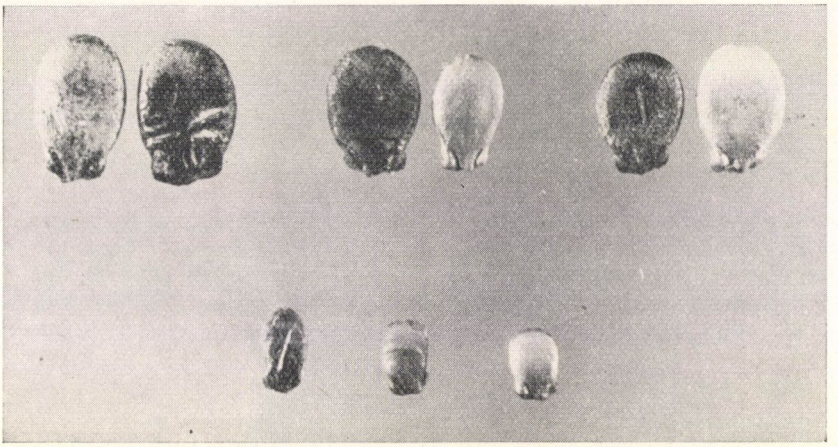

Fig. 5. Tetraploid (left), triploid (centre) and diploid (right) watermelon seeds. Lower row: haploids (Photo: Tóth)

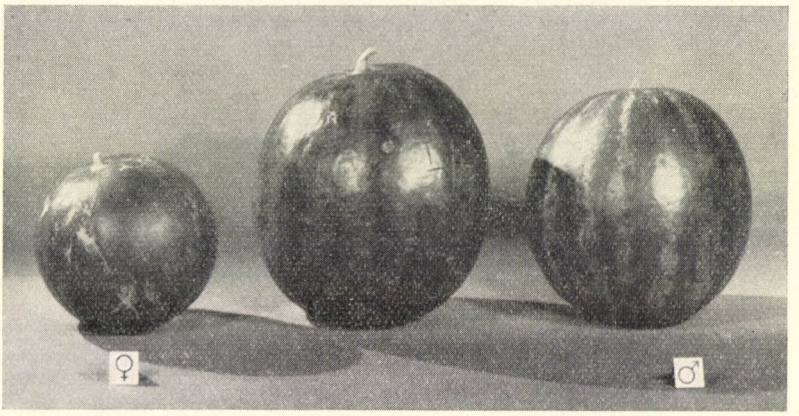

Fig. 6. Dew Green triploids, in the centre (Photo: Tóth)

cause it is difficult to distinguish the hybrids in the progeny of the crossings (Fig. 6).

We needed varieties with such recessive, light-skinned properties whose polyploid form when crossed with the dark-skinned diploid father variety would produce dark-skinned triploid hybrids in the first generation. Such varieties were also found and these polyploids were produced (see Fig. 1).

The next step was to select as great a proportion of triploid seeds as possible before sowing from among the free-flowering seeds. To achieve this, we first separated the heavy seeds from the flatter, lighter ones by a fanner. While we have received almost without exception shriveled, flat hybrid seeds from the successful manual crossings, only 50—60% of the seeds originating from spontaneous crossings are flat and indented. During the second season of growing it became clear that only 30—40% of the shriveled seeds were triploid while the rest tetraploid. It is suprising, however, that even among the progeny of the rounded seeds we had 25—30% triploids. In such a way we could only partially succeed in selecting triploid seeds.

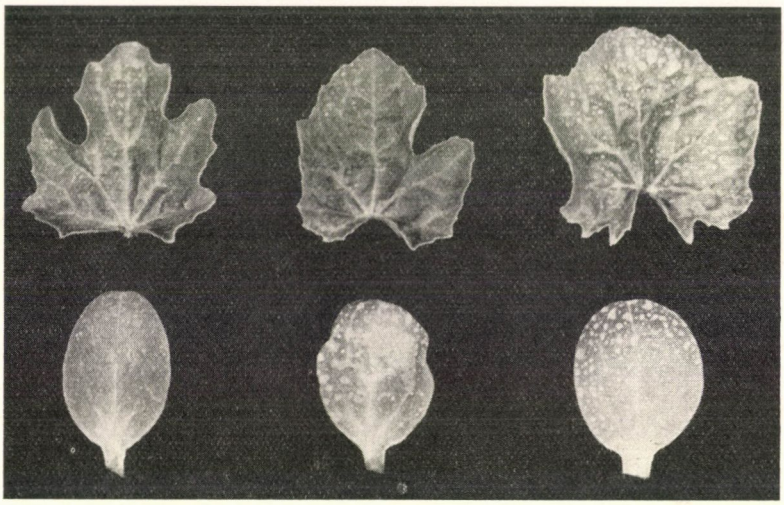

Fig. 7. The cotyledons of the triploid seeds were often deformed (lower row, centre). Left: diploid: right: tetraploid cotyledons. The corresponding primary leaves are in the upper row (Photo: Tóth)

In the cotyledon stage we found still a chance to make another selection. It has been discovered that the cotyledons of the tetraploids are regular shaped, round, elliptical, the diploids are broad, oval-shaped while one cotyledon of triploids originating from crossings is misshapen, deformed in 90% of the cases (Fig. 7). Unfortunately this possibility of selection was not dependable enough.

We have learned that only 60% of the cotyledons of seeds originating from spontaneous crossings were deformed. We gained 30—40% triploid progeny from among the progeny with formless cotyledons and selected in such a way.

Although the mentioned methods of selection were not perfect, still they were suitable for influencing the proportion of triploids among the populations originating from free crossings.

Knowing the described relations of dominance skilled workers can judge with 100% accuracy the triploid fruits in the freely-crossed stock.

It is necessary to mention that the seedless watermelons have only stunted, empty seeds similarly to the young, tender cucumbers (Fig. 8). All the flesh of the fruit is suitable for human consumption without being aware of any seeds during its eating. Occasionally the triploid hybrids also develop large, dark-brown seeds, but in most instances these are sterile: they contain no germ or stored nutrient material. Since these hybrids appear to be the same as those with seeds, these combinations were immediately removed. Our present best combinations are 3—5 kg. in size with a medium-green, firm skin and they are productive.

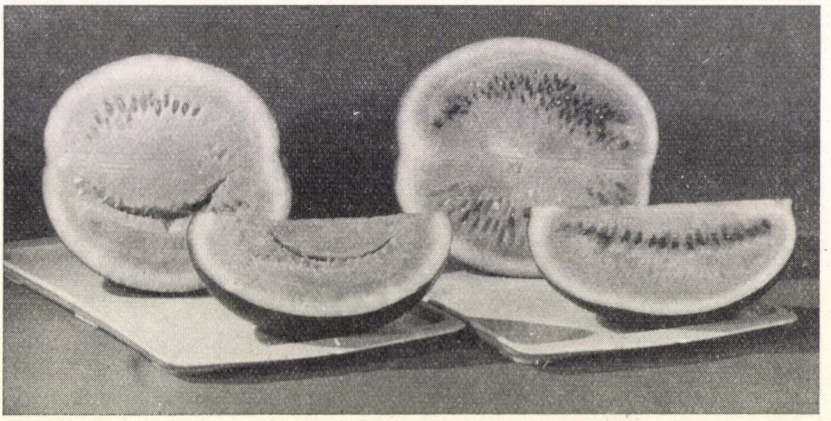

Fig. 8. Triploid watermelons produce only weak, underdeveloped seeds (on the left), on the right: watermelon with seeds (Photo: Tóth)

Conclusions

In 1959 after the japanese example we began our triploid seedless melon experiments and as early as 1961 we reported on minor initial results.

The fruit of the triploid melons, unlike the diploid varieties, are surely tasty and aromatic. Its opponents object to the production expenses of triploid melons.

To begin with even the cost of seed production is expensive as suitable seed set can only be achieved by a $4x \times 2x$ crossing. Since the tetraploids have a small number of seeds anyhow we can count on 40—50 seeds per fruit on the average from the different polyploid levels of crossing. In our first crossings fruit set was only 13.4—15.3%. In 1964—65 we already achieved the 30.0—32.1% level. While in the first years 15.7—19.0% of triploid seeds set, in 1964 already 62.5% sprouted and 50% of the seedlings grew to maturity.

Triploid watermelons in Hungary can be best planted in a proportion of 2 : 1 or 3 : 1 with the pollinating diploid varieties because in pure stock the triploid does not have fruit set on account of sterile male inflorescences. Therefore its production requires greater skill, is more demanding and involves greater risks. Among the present conditions of production the price of seeds is approximately 4,000 Forints per cadastral "hold" thus it would be desirable for the producer to charge at least double the price of common diploid melons per kilogram of first class fruit.

Experiments have been carried out in producing not only the fruits but also the triploid seeds by insect pollination. Our pertinent experiments were only partially successful because we could only slightly increase the proportion of triploids in the population. Even is such a case triploid, seedless fruits can be selected and produced through the proper choice of character of the parental partners with 100% safety and the taste and quality of the fruit can be guaranteed.

On account of the expenses of production it is probable that the triploid watermelon will become widespread only in case it is granted a higher price. Our Institute must set the trend of both seed and fruit production in the proper direction.

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LIGHT-MICROSCOPIC STUDIES ON VOLATILE OIL EXCRETION IN VALERIANA COLLINA WALLR.

II. HISTOCHEMICAL INVESTIGATIONS

By

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In our investigations we have studied, above all, the composition of the sheath layer of the oil-bodies and the changes occurring in the course of the ageing of tissues, respectively, from the solubility and colour reaction of the oil-bodies excreting in the root tissues of *Valeriana collina*. In the course of our work we have elaborated a specific and very responsive colour reaction with the aid of which the process of excretion could be traced from the initiation.

Introduction

On the basis of light-microscopic results and those of other researches made on plants containing volatile oil (balsam) (AHLGRIMM 1956, CZAPEK 1925, KISSER 1958, MORITZ 1962, NYLOV 1929, THUNMANN 1931), the general concept has been established that the quantity and composition of plant volatile oils (balsams) change, depending on developmental stage of the organs and the growth period, to such an extent that when characterizing volatile oil, these data, too, are to be submitted. In the course of our investigations carried out previously (SÁRKÁNY 1958), concerning Valeriana we had pointed also to quantitative changes of volatile oil in connection with the age of organs as well as with the growth period. The composition of oil might change to a great extent even within the same plant according to the spot of excretion and, on the basis of some observations, even according to the chemical structure of the cell wall (FRIDVALSZKY 1957, VIDAL 1903, ZACHARIAS 1879).

Concerning the chemical composition of the volatile oil in the rhizome or root, detailed data are available in the latest literature on pharmacognosia (HALMAI 1963, KARSTEN 1949, MORITZ 1962), however, in this connection we have to emphasize that these data refer to the oil distilled from the plant which differs to a certain extent, from the oil to be found in some tissue regions of the plant. In the distilled Valeriana oil the characteristic volatile component is made up by the ester of borneol with different acids, mostly with isovalerianic acid as well as with camphem and pinen, thus the volatile oil, according to the type of the components, might be ranged among the monoterpenes. Besides,

there had been proved in it a sesquiterpene, too. There occur in the distilled oil also resin, rubber presumably developed in the course of distillation as well as tanning material and sugar. According to observations, the characteristically unpleasant smell of oil is due to the free isovalerianic acid that gets mostly cleaved of the ester only after the drying of the drug and during distillation, respectively.

As to the excretion of intracellular volatile oil within the plant tissues, according to special literature, the oil separates first from the plasma then, surrounded by a sheath, it gets excreted in the oil holder-cells themselves: FREY-WISSLING (1945), MÜLLER (1905), LEHMANN (1925), LEEMANN (1928). The volatile oil excreted and being surrounded with a sheath, is often divided into cupulate and head. BERTHOLD (1886) and BECKER (1931) described the cupulate as a local wall-thickening of cellulose substance. According to MÜLLER (1905) the cupulate comes from the peripheric layers of protoplasma in which he revealed cellulose and later cutin, too. Also LEHMANN (1925) has found the cupulate being of cellulose content, while LEEMAN (1928) qualified both the cupulate and the sheath-layer covering the head, phosphatic containing protoplasma derivative. The same was described by KÜSTER (1956) as a cellulose-like degenerated plasma. After all, our knowledge concerning the excretion, formation and structure of volatile oils is deficient and reflects many a contradictory concept.

Material and Methods

Our solubility and histochemical examinations were made on vertical sections of living cells being at different stages of development. In the solubility examinations 70%, 96%- and absolute alcohols, ether as well as petrol ether were applied.

In the course of our histochemical examinations availing ourselves of methods described generally in scientific literature, we have started to make our observations referring to fatty, and volatile oils, aleuron as well as to substances of the cell wall (GURR 1960, JENSEN 1962, KISZELY 1964, THUNMANN 1931). Moreover, we succeeded in elaborating such a staining process which showed itself to be specific for volatile oils and proved to be suitable regarding sensitivity, too. The applied staining method is the following: Evenly thin cuts made from newly gathered living material were soaked in 1% caustic potash solution for 10 minutes then, after washing out, we have stained with a lugol-solution being diluted to its fifty-fold. Instead of the latter solution of chlorine — zinc — iodine being diluted to its tenfold might also be used. Finally, after washing out the above, we have stained in 0.01% watery toluidine blue solution for 2 minutes. As a result of staining the calyptra oil and the young root cortical oilbody (SZENTPÉTERY *et al.* 1966) were stained bright, turquoise green. It is very essential to lay stress on the dilutions' rate since when applying more concentrated solutions, the metachromatic toluidine blue (SÁRKÁNY 1941) stains the other constituents (nucleus, plasma, suberin, lignin, mucilage) to such an extent that the oil reaction is disturbed. When applying a more concentrated iodine solution, of course, the iodine reactions of the cell constituents are also of disturbing effect (protein, suberin). During the pretreatment in potash lye most of the starch content in the cells get released; the pale violet colouring of starch granules probably remaining behind does not interfere with the oil reaction. The turquoise green colouring ensuing under the effect of the double staining of the oil, gets decomposed within about half an hour.

Results and Discussion

Similarly to the studies on the problems of excretion (SZENTPÉTERY *et al*, 1966), our solubility and histochemical investigations have been performed. starting from the tissues of the resting embryo, in the sprouting roots and later on, in the different regions of the roots of shoot origin.

The fatty oil found in the tissues of the resting embryo dissolves but scarcely in alcohol, while in ether and petrol ether it does get dissolved. When examining the cuts in alcohol, the tiny oil drops of tissues have merged into larger oil drops (fatty oil reaction.)

The calyptra oil of sprouting roots and the developing and already developed roots of shoot origin as well as the young cortical oil get dissolved in 70% alcohol quickly and without any preliminary grouping. In such cases both the calyptra oil and the young cortical oil disappear entirely from the cell showing that the sheath, too, gets dissolved. On the other hand, the older oil-bodies of root cortex origin have not dissolved in 70% alcohol and the sheath-layer has remained back after the release of the oil. However, that sheath dissolved easily in ether and in petrol ether.

Of the hypoderm oil-bodies appearing in the zone of root hairs, only small parts have dissolved in alcohol. Even in ether and in petrol ether a dissolving of only 50—70% was experienced. After all, thorough dissolving could not be obtained; a fact that, among others, shows that the sheath of the hypoderm oil-body contains suberin substances in the early stages already.

In the course of colour reactions, the stored fatty oil of the embryo was proved by applying the usual Sudan IV.

When examining the calyptra and the young root cortical oil-body, it was observed that on the application of stains generally used for tracing volatile oils (Sudan, toluidine blue, Nile-blue, neutral-red, iodine-green, iodine solution, chlorine-, zinc-iodine), no characteristic colour reaction was obtained, at the very most, the oil-holders — similarly to the plasma — got stained by a deeper tint than that. While the hypoderm oil, due to the effect of these stains, unlike the plasma, got coloured similarly to the suberized cell-wall.

In order to follow the course of oil excretion, especially for identifying the initial stages, it was absolutely necessary to find a specific colour reaction. After lengthy examinations we finally succeeded in applying such specific staining process which, as shown already in the paragraph on methodology, brought about the required result due to its sensitiveness and specificity. In the course of the reaction the following process takes place between the two applied reagents and the volatile oil: by the monoterpenes of the oil containing unsaturated bonds, iodine addition occurs at the double bonds thus bringing about their diiodine derivative which, being bound to the amino group of toluidine, binds two molecules of toluidine. That compound produces the characteristic

turquoise-green colour. We succeeded in producing the compound, in vitro, through iodizing the volatile oils containing unsaturated monoterpenes and by adding toluidine. We are going to extend our investigations on the subject also to the components of volatile oils.

The staining method, its specificity referring to volatile oils, have been tried with such other plants containing volatile oil, the volatile oil of which contains also unsaturated monoterpenes. Colouring occurred in each case whether oil excreted in oil-duct, in glandular hairs or in oil-cell. That staining has been extremely helpful in the course of studying the separation and excretion, respectively, of volatile oils. As already written about in our previous publication (SZENTPÉTERY *et al.* 1966), from the plasma the volatile oil gets excreted directly on the cell-wall without any preliminary separation. This initial drop could be revealed only through the application of the new colour reactions. On the other hand, in our comparative investigations it was possible in case of e.g. *Foeniculum vulgare* and *Ruta graveolens* to disclose, before excretion, small volatile oil drops separated from the plasma.

This volatile oil reaction is not produced at all by fatty oils, therefore, it is also suitable for discerning fatty and volatile oils having been so far difficult to tell them apart in plant tissues.

When examining the cortical oil of secondarily thickened root, in connection with double staining we have experienced the reaction to be less sensitive and to ensue only after several minutes and the colouring to be paler. From this we have concluded the penetrating of the reagent to be hindered by substances accumulated in the sheath (see later).

The effect of staining on the hypoderm oil was very interesting. As a response to the double staining performed in the zone of root hairs, it displayed yellowish-brown tint similarly to the suberized cell-wall, however, paler than that. After lengthy examination we have succeeded in establishing that if on the occasion of cutting, the sheath-layer of the hypoderm oil is injured, oil reaction can be produced by double staining. From this it has been concluded that the sheath-layer of the hypoderm oil contains suberin already in the zone of root hairs, a fact that has already been proved by the solubility and the general staining methods.

In the course of our further investigations we have obtained conspicuous differences also with Sudan IV reaction carried out in the different zones of root. Calyptra oil and cortical oil in the zone of root hairs showed no response to Sudan. The hypoderm oil of the root hairs zone became yellow from Sudan IV thus showing already a slight lipoid reaction. Above the root hairs zone in primary roots the hypoderm oil became darker and darker as an effect of Sudan IV, and here also the cortical oil began to grow yellow. As for the secondarily thickened root, here both the cortical and the hypoderm oil-body show intense Sudan reaction. On the basis of our investigations we have established

that in the sheath-layer of the young hypoderm oil suberin and other substances of lipoid character have already been deposited. In the course of the secondary thickening of root there starts the deposition of lipoid in the sheath-part of the cortical oil; this is being proved, besides staining, also by solubility conditions. We want to stress, however, that after alcohol treatment the old cortical oil does not produce with double staining no more oil reaction; thus, the oil itself has got released and only the lipoid containing sheath remains. From the examinations it could also be established that contrary to hypodermal oil, the sheath of cortical oil does not contain suberin even when old, and this is why it easily dissolves in ether and petrol ether.

In order to get better knowledge of the nature of lipoids depositing in the sheath of the oil-holders, we have made Nile-blue sulphatic examinations on the basis of which we have established that cortical oil staining red through Nile-blue sulphate contains neutral lipoids. The hypoderm oil becomes blue through the stain, — which allows us to conclude that phosphor containing lipoids are present.

In the course of our examinations it has been noticed that the characteristic smell originating from isovalerianic acid, is noticeable in the *Valeriana* root only from the start of hypoderm oil excretion. Calyptra oil, the oil of root hairs zone and of primary root cortex are odourless. On the other hand, in the root secondarily developed even cortical oil is of typically isovalerian smell. It is supposed that in calyptra and in young root cortical oil, besides borneol and the esthers, no free isovalerianic acid develops or does not cleave off the esther. On the other hand, in hypoderm oil, besides the esthers, large quantity of isovalerianic acid, develops, too. In the course of our further investigations, by applying histochemical methods already available as well as with the aid of new methods, we try to prove — at microscopic scale — the formation of components of oil in connection with the development of tissues.

Conclusion

In the course of our histochemical investigations carried out in the *Valeriana collina* root-tissues of different age and development, we have succeeded in elaborating and producing, in vitro, a very sensitive colour reaction being specific for terpenes. The application of the method lent much assistance, above all, in identifying the volatile oils and in studying the separation and excretion of volatile oils.

While studying in the course of development the decayed sheath being of plasmatic origin, it has been established that neutral lipoids deposit in the sheath of root cortex origin only in the course of the secondary thickening of root while the sheath of hypoderm oil-bodies contain suberin and some lipoid

as early as at their appearance. Later on phosphor containing lipoids, too, accumulate in the sheath.

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DRY MATTER ACCUMULATION IN THE STALK- AND LEAF-LEVELS OF MAIZE

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The dry matter content in the internodes and leaf-blades at the different levels of the organ in the hybrid maize *Martonvásári 1* has been studied in the period between shooting and milky ripeness. Dry matter accumulation in the organ-levels increases upwards the top. In the stage of milky ripeness the dry matter content is higher and it increases acropetally. In the case when grain formation is detained, the dry matter content of the vegetative organs is lower. There exists correlation between the location and the developmental stage of the female inflorescence and the dry matter accumulation of the vegetative organs.

Introduction

The accumulation of dry matter in the vegetative organs of maize has been studied enough — especially in trials for establishing the optimum cutting time of silage maize. These trials, however, do not involve the detailed analysis of dry matter accumulation in the reproductive phase, thus from the submitted data no uniform conclusions can be made.

HANWAY (1962a) shows that the increase of the leaf-mass of maize is, practically, finished by the time of flowering. After pollination the whole life-function of the plant serves the accumulation of organic matter in the grain. From this time on, the growth of vegetative organs, their organic matter accumulation begins to decrease or comes to an end, respectively. Nutrient supply (HANWAY, 1962b), the physiological stage of the plant (BERKO 1963b), however, exert influence on the decrease of the accumulation of vegetative organs and the size of leaf surface. Most probably, this is the explanation of contradictions occurring in literature and referring to the problems of dry matter accumulation (ANDREJENKO—KUPERMAN 1961, FERENCZ 1958, HANWAY 1962a, HAY *et al.* 1953, SAYRE 1948, ZHURBIZKIJ 1963).

The decomposition of organic matters accumulated in the vegetative organs and their translocation into the ears (HAY *et al.* 1953) can ensue, under optimum conditions, only at the end of the growing season when the decrease of the physiologic activity of the organs cannot diminish the nutrient accumulation of the grain since it has practically finished. Thus BERKO (1963a) observed that the daily weight increase in the over-ground organs of maize shows

the maximum at grain formation. According to YERMILOV (1962) the efficiency of maize leaves is higher at the time of the grain formation. The dry matter accumulation of vegetative organs is also considerable though the dry matter accumulation of the ear during this period is considerably greater.

In the present paper we examine the changes occurring in the dry matter content of the stalk- and leaf-levels of the hybrid maize, *Martonvásári 1*, with special regard to the period of grain formation.

Material and Methods

Our trial of the year 1964 was performed in the lime-coated chernozjom soil of the experimental garden of the Agricultural College. *Martonvásári 1* hybrid maize was planted in 70 × 50 cm spacing on April 23. The first three samples had been taken as early as the period of vegetative growth with one week difference, between June 10 and June 24. The later samples were analysed on the appearance of the tassel, at flowering, at the silk getting dry, and in the state of milky ripening. Sampling was carried out in the morning hours between 8 and 10 o'clock.

With part of the stand, in order to prevent pollination, the ears had been covered with isolating paper bags before the appearance of the silks. The dry matter content of the individual plants of that group was determined simultaneously with plants having normal life-cycle, when the latter were in the state of milky ripening.

At sampling 10—10 plants were chosen. From the leaf-blades the main vein was removed, the stalk cut to pieces by internodes. The leaf-blade and internode, respectively, being at the same level on the plant, constituted an average sample. After having determined the fresh weight, the samples were, immediately, dried at temperatures not exceeding 50° C, and then stored in paper boxes until being worked up. From air-dry samples ground the dry matter content was determined on the basis of drying performed at 105° C.

The numbering of leaves and internodes occurred in acropetal sequence. The lower leaves had generally withered off by the time of flowering. Thus, according to our numbering, the upper ear was located in the axil of the 8th leaf. On numbering the internodes, the internode below the leaf got a numbering identical with the leaf.

Results and Discussion

The dry matter content in the leaf-blades of maize in the different stages of ontogenesis, is shown in Fig. 1. — At this time of shooting the accumulation of dry matter in the leaf-blades is very intensive. The dry matter content of young leaves being still in growing stage, is low. The dry matter content of leaves decreases acropetally. The dry matter content in samples of leaf-blades taken at tasseling is nearly the same. The development and location of the upper ear, exert a considerable influence on the dry matter accumulation of vegetative organs. At the beginning of tasselling the maximum of dry matter content is in the 8th leaf-blade in the axil of which the upper ear is located. The dry matter content of leaves above the ear, especially at the top, is lower. The dry matter content in the leaf-blades below the ear taken at the time of tassel-flowering, allowed to be seen hardly any change in the period between the two samplings. While on the other hand, the dry matter content in leaf-blades above the upper ear had increase also in that phase, and as compared to the lower

leaves, it gained higher values. By the time of milky ripeness the dry matter content of the leaf-blades increased approximately to the same extent. The maximum was in the leaves below the top and the dry matter content of the upmost leaves was less at that phase, too.

The dry matter accumulation of the internodes (Fig. 2) shows peculiarities different from the above. When comparing the two Figures, it can be seen that the increase of dry matter content in the internodes lags behind that of

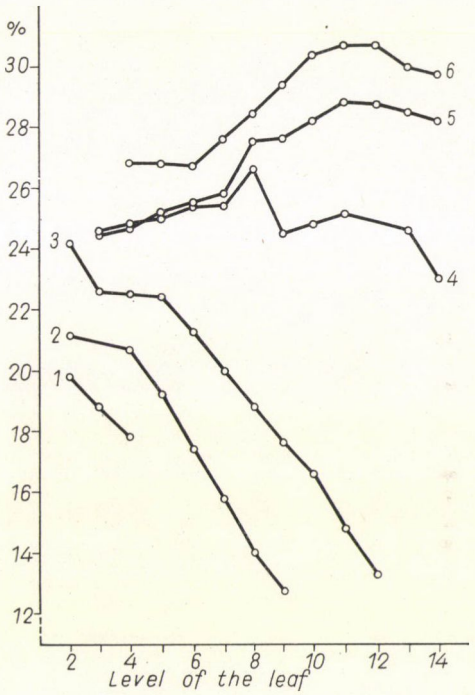

Fig. 1. Dry matter content in the leaf-blades of maize during the different stages of ontogenesis. 1—3: at the time of shooting (with differences of one week); 4.: tasseling; 5.: flowering; 6.: milky ripeness

the leaves. While at the beginning of tasseling the dry matter content in leaf-blades being at different levels, is nearly identical, that of internodes shows definite acropetal decrease. The increase of dry matter content in the upper internodes lessens at the time of flowering. Except the upmost internodes, accumulation is of lower rate by the time of milky ripening. The maximum has been experienced at pollination around the ear where as in milky ripeness in the upper internodes. When comparing the two organs, it can also be established that while in the case of leaf-blades after flowering the dry matter content increases acropetally, in the case of internodes the minimum is below the ear. It has been observed that after the flowering the dry weight of the internodes

below the ear is the highest, and at the same time they contain the least dry matter.

The above prove the intensive dry matter accumulation of the vegetative organs even after tasselling. From all this it can be established that from analytical data referred to dry matter, incorrect conclusions might be made. Thus, it seems to be more advisable to avoid references to dry matter, — this latter being a most varying basis. It is true that the water content of the plant

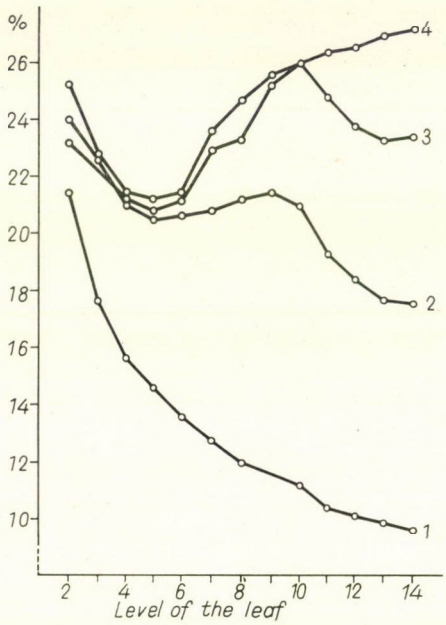

Fig. 2. Dry matter content in the internodes of maize during the different stages of ontogenesis. 1.: at the time of tasseling; 2.: flowering; 3.: cease of flowering; 4.: milky ripeness

organs is variable which may be considered as a source of error in the present case. In the case of optimum water supply, however, we needn't reckon with that possibility of error. The reference to a whole organ is, on the other hand, interfered by the growing of the organs.

LATKOVICS—MÁTÉ (1963) point to the fact that the dry matter accumulation of the young maize plant (when examining the first ten-week period) is very intensive and therefore the N-content as referred to dry matter, though the N-accumulation of plants is considerable, gets lessened nearly to its 1/3rd during the period examined. This, provided the high-rate accumulation of the dry matter is not taken into consideration, might lead to faulty conclusions.

On the basis of the analysed data it can be established that the accumulation of dry matter in the vegetative organs of the maize plant *Martonvásári 1* does not stop after pollination when grains start to develop. The dry matter

content both in leaf-blades and in internodes is higher with maize being in the milky ripeness. These examinations, however, do not submit sufficient basis for analysing the correlations. The after-pollination period in the life-cycle of annual plants entails the ageing of the organism. However, physiologic activity cannot decrease in that period either, — since the development of grains, the formation of reserve nutrients make us presume intensive photosynthesis.

How does the dry matter content of the vegetative organs take shape in the case of maize, compared to the control plants, if no pollination occurs? If the physiologic stage of the vegetative organs, the productivity of leaves are in close correlation with the presence of the ear and its developmental stage,

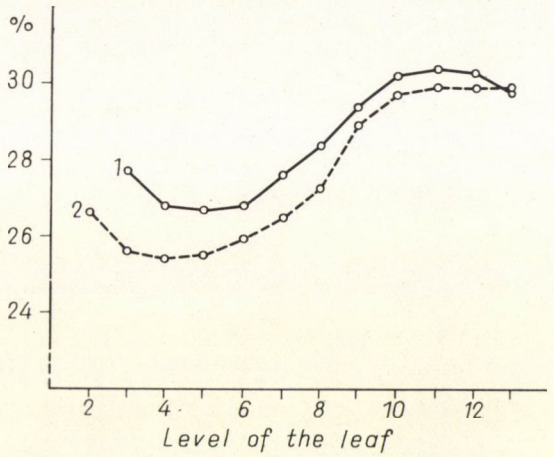

Fig. 3. The effect of the absence of pollination on dry matter content in the leaf-blades of maize. 1.: control; 2.: without pollination

respectively, (YERMILOV 1962, ZEMSKI 1959) it might be supposed that in the absence of pollination and grain formation, respectively, this would entail a reduced increase of dry matter as compared to the control plants carrying on normal life-cycle. The approach of this problem has been served by our experiment in which pollination has been prevented with a part of the stand.

The dry matter content in the leaf-blades (Fig. 3) and internodes (Fig. 4) of the two plant groups show considerable differences in the phase of milky ripeness. As compared to the controls, in the unpollinated plants the dry matter content of both the internodes and leaf-blades is lower. From the data of the Figures we might conclude that the increase of dry matter content in the vegetative organs of maize in the period between pollination and milky ripeness is due to the physiological relationship between the activity of these organs and the grain yield, and it will fail to come about if pollination and, as a consequence, the formation of the grains are prevented.

The higher dry matter content observed at the time of tasselling in the leaf-blade near the ear, agrees with the observations of ZEMSKI *et al.* (1961). According to them the development of the ear brings about xeromorph special features in the leaves around the ear.

From the experiments of ZEMSKI (1959) concerning the accumulation of phosphor isotope in the leaf-blades of maize, we might conclude that the presence of the ear results in the enhanced physiological activity of the sorrounding leaves.

On the basis of the analysed data, in accordance with the data of BERKO (1963a, b) and YERMILOV (1962) it can be established that the dry matter con-

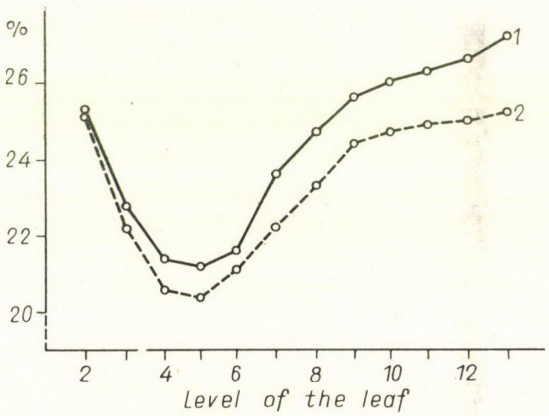

Fig. 4. The effect of the absence of pollination on dry matter content in the internodes of maize. 1.: control; 2.: without pollination

tent and physiological activity in the vegetative organs of maize does not decrease in the period of grain formation. The translocation of the accumulated nutrients into grain is supposed, during this period, to ensue only under unfavourable circumstances wich hinders the realization of the potential amount of grain yield (HANWAY 1962a). If in this period part of the organic matter accumulated in the vegetative organs, translocated into the grain, when grain formation was prevented, higher dry matter content ought to have been experienced in these organs.

Conclusions

The changes of the dry matter content occurring in the internodes and leaf-blades of the hybrid maize *Martonvásári 1* were studied in the period between shooting and milky ripeness.

The data show the dry matter accumulation in the leaf-blades of maize to be of various intensity at the different leaf-levels in the course of vegetation.

While the dry matter content of leaf-blades being in vegetative phase decreases acropetally, at the time of milky ripeness acropetal increase can be observed. The changes in dry matter content get enhanced towards the top. The dry matter accumulation continues after tasseling as well. On the basis of analytical data it is suggested to avoid making analytical data referred to the dry matter.

Changes of similar character occur in the internodes, however, here the accumulation of dry matter is slower as compared to the leaf-blades. At the beginning of the reproductive phase the dry matter content of leaf-blades and internodes around the ear is higher. It can be supposed that the development of the female inflorescences enhances the dry matter accumulation, and thus the physiological activity of the neighbouring vegetative organs.

The increase of dry matter content experienced at the beginning of the reproductive phase, does not take place if grain formation is prevented, — a fact that also proves the close relationship between the female inflorescences and the physiological activity of the vegetative organs.

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COMPARISON OF THE MAIN CHARACTERISTICS OF CYTOPLASMATICALLY MALE STERILE AND FERTILE ANALOGOUS HYBRIDS

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In 1963 a comparative study was made of 127 pairs of sterile and fertile hybrid analogues in Krasnodar in order to discover the effect of male sterile cytoplasm. In comparing the male sterile analogous hybrids to fertile hybrid analogues it became clear that the former were more productive. The plants themselves as well as their internodes, especially above the ear-producing zone are shorter, although the number of their nodes hardly differs from that of fertile hybrid analogues. It was also possible to determine that male sterile plasma had been effective already at very early stages of development in the individual plants; moreover the degeneration and sterility of male sexual organs were not its only results.

At this point generalizations cannot yet be made on the basis of my experiments; the results can only be used for illustrating the treated variations of the Soviet hybrid material employed.

Introduction

The importance of cytoplasmic male sterility in the production of hybrid maize is steadily increasing throughout the world because the productivity of cytoplasmically male sterile hybrids is not below that of normal fertile hybrids and because their production — having no need for detasseling — is simpler and cheaper. Several researchers such as ROGERS—EDWARDSON (1952), JONES—STIMSON—KHOO (1957), DUVICK (1958), HADZHINOV (1962), KOVARSKI —CHALIK (1962), GALEYEV (1963) and ZAYSHLI (1963) carried out comparative studies of the productivity of fertile and male sterile hybrids. Their experiments have proved the productivity of male sterile hybrids to be identical with — and in certain cases even greater than — that of fertile hybrids. Recently DUVICK (1958), HADZHINOV—VAKHRUSHEVA (1963), and KOZUBENKO—ZAYSHLI (1963) have reported that the relation of the productivity of the same male sterile and fertile hybrids may be different, depending on climatic and growing conditions. Several experimental data show that male sterile hybrids are more fertile under conditions of moisture deficiency. HADZHINOV—VAKHRUSHEVA (1963) and ROGERS—EDWARDSON (1952) pointed out that the genotypes reacted differently to male sterile cytoplasm. Therefore it is important to select genotypes that, from an economic viewpoint react favourably to the male sterile cytoplasm. Literature also indicates that we must not examine the effect of male sterile cytoplasm on arbitrary genotypes among dif-

ferent environmental conditions without considering the special reaction of the given genotype to the male sterile cytoplasm. Bearing all these in mind I examined the differences among the main characteristics of male sterile and fertile hybrid analogues in Krasnodar in 1963.

Material and Methods

In 1962 127 pairs (sterile-fertile combinations) were prepared for the purpose of study. The hybrids were classed into four groups according to the length of the growing season:

Group 1 — very early maturing, standard *Bukovina 3* hybrid
Group 2 — early maturing, standard *VIR 25* hybrid
Group 3 — medium-late maturing, standard *VIR 42* hybrid
Group 4 — late maturing, standard *VIR 156* hybrid. In the first group 10, in the second 39, in the third 60 and in the fourth 18 pairs of hybrids were examined.

In order to make the proper comparison the sterile and fertile analogous hybrids were sown in pairs in 4 replicates with 20 hills in each row. In case of the early maturing hybrids 70×40 cm. and for the late maturing hybrids 70×50 cm. distances were used. In 1963 during the course of the experiment the weather was dry with 167.1 mm of precipitation (throughout the entire growing season) while the average of many years is 221.0 mm. The experimental plot was productive and composed of deep, clayey, chernozem soil.

Results and Discussion

During the experiment I were examined: 1. productivity of the hybrids, 2. time of the appearance of stigmas on 75% of the plants, 3. height of the plants, 4. height of the ears, 5. number of nodes above ground, 6. number of female inflorescences bearing stigmas, 7. number of tillers, 8. moisture content of the grains at harvesting, 9. shelling proportion, 10. weight of the tassels of sterile and fertile analogous hybrids at the beginning of blossoming and 11. length of the tassel and number of its branches.

The results of comparative yield tests show that in almost every group the sterile hybrids produce a higher yield than approximately identical proportions of fertile hybrids. Thus the sterile hybrids in

Group 1	produced	80 %
Group 2	„	79.4%
Group 3	„	75.0%
Group 4	„	83.3%

more than did the fertile hybrids. The results of comparative yield tests are given in Table 1.

As the data of the table show, the sterile hybrids of each group surpassed their fertile analogues by 3.0—4.4 quintals dry kernels /ha, i.e., by 6.6—13.1%. In every group this difference in yield is dependent on the level of $P = 0.95$.

Table 1

Comparative yields of male sterile and female hybrid analogues

Hybrid groups	No. of pairs of hybrids used	Mean corn yield of fertile hybrids with 14% moisture content q/ha	Difference in yields between fertile and sterile hybrids q/ha	Yield difference in %	Deviation from mean square of difference q/ha	Mean error of mean deviation q/ha	Real value of "t"	Significance at P = 0.95 level
Very Early Maturing	10	32.7	+4.3	+13.1	4.7	±1.6	2.6	significant
Early Maturing	39	42.8	+3.5	+ 8.2	5.1	±0.8	4.3	significant
Middle Maturing	60	45.4	+3.0	+ 6.6	5.6	±0.7	4.2	siginificant
Late Maturing	18	47.7	+4.4	+ 9.2	4.3	±1.0	4.4	significant

Data on the heights of the plants are included in Table 2. The results show that the sterile analogous hybrids are shorter than the fertile ones and thus the pertinent data of NIL—STROMEN (1956), KUPERMAN (1959), HADZHINOV—VAKHRUSHEVA (1963) and others find support.

In

Group 1 70 % of the sterile combinations
Group 2 94.9% of „ „ „
Group 3 95 % of „ „ „
Group 4 100 % of „ „ „

were shorter than the fertile hybrids. My own experiments prove in agreement with the views of several authors that the difference between the heights of plants is smaller for those groups with shorter growing seasons, while for those with longer growing seasons, it is greater.

Table 2

Data on the height of male sterile and fertile hybrid analogues

Hybrid groups	No. of Pairs of hybrids used	Aver. height of fertile hybrids in cm	Height deviation of sterile from fertile hybrids		Deviation from mean square of difference cm	Mean error of aver. deviation cm	Real value of "t"	Significance at P = 0,95 level
			cm	%				
Very Early Maturing	10	191.7	— 6.9	—3.6	11.0	±3.5	2.0	—
Early Maturing	39	213.7	— 9.3	—4.4	6.6	±1.1	8.7	significant
Middle Maturing	60	241.7	—14.6	—6.0	7.6	±1.0	15.1	significant
Late Maturing	18	247.4	—17.0	—6.9	6.9	±1.6	10.5	significant

Table 3

Height attained by the upper ears of male sterile and fertile hybrid analogues

Hybrid groups	No. of pairs of hybrids used	Aver. height of fertile hybrid ears cm	Deviation of the height of sterile hybrid ears from fertile hybrids		Deviation from the mean square of difference	Mean error of aver. deviation	Real value of "t"	Significance at P = 0.95 level
			cm	%				
Very early maturing	10	55.4	−3.7	−6.7	5.3	±1.7	2.2	—
Early maturing	39	72.1	−2.2	−3.1	4.2	±0.7	3.3	significant
Middle maturing	60	100.5	−4.6	−4.6	6.2	±0.8	5.8	significant
Late maturing	18	97.3	−4.4	−4.5	4.0	±1.0	4.6	significant

The data concerning the height of the ears may be found in Table 3. The difference between the heights of the ears of sterile and fertile hybrids is not as great as in case of plant height: it amounts to 3.1—4.6%.

The plant height and the height of the ear are closely related to the number of nodes above ground which in turn is related to the number of leaves. KULESHOV (1931) holds that this property is less altered by different environmental factors. Table 4 contains the data on the number of nodes above ground of the sterile and fertile hybrids. According to this table there is an insignificant reduction in the nodes of the male sterile analogues equalling approximately 1.7% for all the hybrid groups. At the same time there is a 4.7% reduction in the height of the ears and a 5.2% reduction in plant height. From this it may be concluded that the number of leaves is relatively less dependent on the sterile cytoplasm.

Table 4

Comparison of the number of nodes above ground on male sterile and fertile hybrid analogues

Hybrid groups	No. of pairs of hybirds used	No. of nodes above ground on fertile hybrids	Deviation of no. of nodes of sterile hybrids from fertile hybrids	Deviation of no. of nodes of sterile hybrids from fertile hybrids %	Deviation from mean square of difference cm	Mean error of aver. deviation	Real value of „t"	Significance at P = 0.95 level
Vary early maturing	10	9.6	−0.15	−1.7	0.08	±0.03	5.0	significant
Early maturing	39	10.7	0.0	0.0	0.09	±0.01	2.9	siginificant
Middle maturing	60	13.1	−0.4	−2.6	0.50	±0.06	5.8	significant
Late maturing	18	12.7	−0.3	−2.4	0.70	±0.2	1.7	—

Table 5

Weight of the tassels of male steril and fertile hybrid analogues

Hybrid combination	Weight of 20 fertile hybrids	Tassels in grams male sterile hybrids	The weight of the tassels of male sterile hybrids compared to those of fertile tassels %
A	988	507	51.3
B	687	334	48.8
C	655	347	53.0
D	700	382	54.6
E	749	371	49.9
F	824	413	50.1
G	720	396	55.0
Average	38.0	19.6	51.7

In comparing the productivity of sterile and fertile analogous hybrids the number of ear shoots possessing stigmas has an important role. Namely, a greater number of ear shoots means that a greater number of ears can be formed (i.e., a higher yield). Naturally a great number of female inflorescences does not always result in a greater number of ears. It is possible that the nutrients saved by the male sterile hybrids — which do not use any nutrients for forming pollen — go into the formation of female inflorescences. Thus male sterility may be conducive to the formation of more female inflorescences which result in more ears or grain. My data support this hypothesis. I examined the tassels of 7 pairs of (sterile and fertile) hybrid combinations precisely at the time when the anthers of the fertile analogues appeared. The hybrid analogues were sown in adjacent rows: twenty tassels of each combination were weighed. The results are given in Table 5. As we can calculate from the table, the tassels of male sterile hybrid analogues are 48.4% lighter than those of the fertile analogues. From this it can be computed that 35,700 male sterile plants/ha during pollen production save $35{,}700 \times 18.4$ grams(or 657 kg/ha) biologically excellent nutritive material which can be turned into the formation of female inflorescences. Thus we can explain the results gained by the comparison of the number of female inflorescences in Table 6: generally speaking the number of female inflorescences is always greater for male sterile hybrids. This is observable in

80 % of the hybrid combinations of Group 1
84.6% of „ „ „ „ „ 2
90 % of „ „ „ „ „ 3
83.3% of „ „ „ „ „ 4.

Table 6

Number of male sterile hybrid analogue female inflorescences per 100 plants

Hybrid groups	No. of pairs of hybrids used	No. of female infl. per 100 fertile hybrid plants	No. of female infl. on sterile hybrids in relation to fertile hybrids per 100 plants	No. of female infl. on sterile hybrids in relation to fertile hybrids %	Deviation from the mean square of difference	Mean error of aver. deviation	Real value of "t"	Significance at P = 0.95 level
Very early maturing	10	105.5	+ 5.0	+ 4.7	12.5	±4.0	1.3	—
Early maturing	39	113.0	+ 9.0	+10.8	13.0	±2.0	4.3	significant
Middle maturing	60	115.5	+12.0	+10.0	13.5	±2.0	6.8	significant
Late maturing	18	133.5	+ 8.0	+ 5.6	10.5	±2.5	3.4	significant

In examining the productivity of sterile and fertile analogous hybrids I was also concerned with the amount of tillering. Data on tillering are contained in Table 7. From this it may be seen that there is less tillering in sterile hybrids. My data on the tillering of sterile hybrids correspond to those of DUVICK (1958) who, in case of 6 pairs of hybrids, significantly proved that tillering had been 12% less in sterile hybrids. These results lead to the conclusion that the male sterile cytoplasm affects the plant at an early stage of development.

It is known that the amount of time between male and female inflorescences on maize is a good indication of the growing conditions. Among favourable circumstances the time span is reduced and among adverse conditions this period is lengthened. Table 8 contains the data on the period of female inflorescence in sterile and fertile analogous hybrids. Among the sterile analogous hybrids female inflorescence started 0.4—1.3 days sooner than it did among

Table 7

Number of tillers on male sterile and fertile hybrid analogues, per 100 plants

Hybrid groups	No. of pairs of hybrids used	No. of tillers on fertile hybrids	Deviation of the sterile hybrid tillers from the no. of fertile hybrid tillers	Deviation of sterile hybrid tillers from those of the fertile hybrids %	Deviation from the mean square of difference	Mean error of aver. deviation	Real value of "t"	Significance at P = 0.95 level
Very early maturing	10	99.5	—10.5	—10.5	32.0	±10.0	1.0	—
Early maturing	39	48.0	— 7.5	—15.6	20.5	± 3.5	2.3	significant
Middle maturing	60	70.5	— 8.0	—11.3	15.0	± 2.0	4.2	significant
Late maturing	18	28.0	— 4.5	—16.0	24.0	± 5.5	0.8	—

Table 8

Number of days until female inflorescence occurs among male sterile and fertile hybrids

Hybrid	No. of pairs of hybrids used	Fertile	Sterile	Difference in days until female inflorescence (in %) in favor of sterile	Deviation from the mean square of difference	Mean error of average deviation	Real value of "t"	Significance at P = 0.95 level
		No. of days until female inflorescence occurred						
		no.	deviation from sterile					
Very early maturing	10	57.6	−1.2	−2.1	1.1	±0.4	3.3	significant
Early maturing	39	61.8	−1.2	−1.9	1.7	±0.3	4.4	significant
Middle maturing	60	63.5	−1.3	−2.0	1.1	±0.1	9.3	significant
Late maturing	18	65.5	−0.4	−0.6	0.7	±0.2	2.4	significant

the fertile plants in all four maturity classes. This follows from the more intensive growth of the female inflorescence of sterile hybrid analogues. Here probably the same causes are in effect that resulted in the greater number of female buds on the sterile hybrids.

In addition to those characteristics influencing the yield, in the study of sterile and fertile hybrid analogues we have examined a few characters which do not directly affect the yield. Such a character is, for instance, the length of the tassel and the number of its primary and secondary offshoots. The pertinent data are found in Table 9. From this table it may be seen that the tassels of sterile analogous hybrids are generally 5.5% shorter than those of the fertile plants. There are also differences in the number of primary and secondary branches. The number of primary offshoots on the tassels of sterile hybrids is

Table 9

Length and number of offshoots of tassels of male sterile and female hybrid analogues

Hybrid combinations	Number of offshoots on tassels						Deviation of the tassels of male sterile hybrids from those of the fertile hybrids, in %		
	Fertile			Male sterile					
	Length cm	Primary	Secondary	Length cm	Primary	Secondary	Length of tassel	Number of primary offshoots of tassels	Number of secondary offshoots of tassels
A	57.8	22.9	5.7	54.4	17.0	4.5	94.16	74.2	78.9
B	58.0	20.8	5.5	54.5	16.7	4.8	93.9	80.3	87.2
C	57.4	20.2	6.0	55.5	14.5	4.3	96.6	71.7	71.6
D	56.0	20.4	7.2	52.3	15.4	4.4	93.3	75.5	61.1
Average	57.3	21.0	6.1	54.1	15.9	4.5	94.5	75.4	74.7

Table 10

Shelling proportion of male sterile and fertile hybrid analogues

Hybrid group	Shelling percentage of fertile hybrids	Deviation of shelling percentage of male sterile hybrids in comparison to fertile hybrids
Very early maturing ...	82.7	−0.02
Early maturing	83.8	+0.16
Middle maturing	82.5	+0.73
Late maturing.....	82.4	+0.52

reduced by 19.7—28.3% while the secondary offshoots by 12.8—38.9%. This also proves that sterile cytoplasm makes its effects felt at an early stage of ontogenesis, i.e., when the offshoots of the tassel are being formed.

Definite regularities were observed in the shelling proportion and in the moisture content of the grains at harvesting (see Tables 10 and 11). The more favourable shelling proportion is produced by the sterile hybrids. This corresponds to the increased productivity of sterile hybrids as noted in the present experiment. The moisture content of the harvest was generally 0.3—0.5% less in case of sterile hybrids. This coincides with the fact that among the sterile hybrids the period of female inflorescence usually occurred 0.4—1.3 days sooner than among the fertile ones.

Table 11

Moisture content of the kernels of male sterile and fertile hybrid analogues at harvesting

Hybrid group	Moisture content of fertile hybrids in %	Deviation of the moisture content of male sterile hybrids from that of the fertile plants
Very early maturing	18.0	+0.2
Early maturing	18.5	−0.3
Middle maturing	21.5	−0.3
Late maturing	22.2	−0.5

Conclusions

In 1963 I compared 127 pairs of sterile and fertile hybrid analogues in order to study the effects of male sterile cytoplasm. On the basis of my examinations I made the following conclusions:

The male sterile analogous hybrids prove to be more productive than the fertile ones this is consistent with several other properties.

The larger number of female inflorescences on male sterile hybrids, their better shelling proportion, their savings of nutritive material during pollen production and finally the quicker development of ears are all related to producing a higher yield.

It was possible to ascertain that the height of the plant is most easily affected by transplanting the given genotype into sterile cytoplasm.

The reduction in the height of the male sterile plant can be primarily attributed to the reduction in the length of the internodes.

The internodes of male sterile plants became less short below the height of the ears than above. This is related to the movement of food substances.

The number of nodes on male sterile plants was only insignificantly reduced.

The experimental results prove that male sterile cytoplasm can make its effects felt at much earlier stages of ontogenesis than it has been previously supposed when its only effect was thought to be the degeneration of pollen.

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THE RAW PROTEIN: RAW FIBRE RATIO IN LUCERNE AND SOYBEAN

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The raw protein : raw fibre ratio in papilionaceous roughages was studied in 1955—56—57—61—62, first of all in lucerne, subsequently also in soybean, to ascertain whether there is a relationship and if so, of what kind, because if there is, then it is sufficient to determine raw protein in the laboratory, and the lengthy analysis of raw fibre can be omitted.

Introduction

It is necessary to be acquainted with the raw protein contents of roughages, in order to be able to carry out correctly the rational feeding of live-stock. It is not sufficient, however, to reckon with the raw fibre content as it appears from the Tables, since the actual raw protein content in the practice often substantially differs from the former.

The difference may have various causes. The actual raw fibre content of the same roughage depends decisively on the data of cutting and/or the developmental stage of plant as well as on weather conditions, and, to a certain extent, also on the composition of the soil. Finally raw fibre content of the fodders may also be influenced by the conditions of harvesting and curing or conservation.

The raw fibre content must therefore be analysed in laboratory for all roughages and if possible separately the fodder conserved from each cutting in order to ensure the best use of it by proper blending.

This is particularly important in our days when even to live stock consuming raw fibre to a little extent only (poultry, pigs) roughages are fed at a certain ratio with preference, owing both to physiological reasons and to the reduction of costs of production. If, however, we rely on the raw fibre contents found in the Tables we may obtain very different and even contrary effects to the desirable, in respect of feed utilization and results of animal production.

The laboratory determination of raw fibre, however, is a procedure requiring much labour and time so that if it could be done without it, time and cost of fodder analysis could be saved. Being well known that there is some sort of relationship between protein and fibre content it seemed useful to investigate the nature of this relationship and to find out whether it is

possible merely by the determination of protein to draw comparatively exact conclusions on the raw fibre content of the roughages referred to. This would mean indeed a help both for the practical animal breeder and the analyst.

Therefore the several hundred samples of hay and hay meal collected in the years 1955—56—57—61—62 from lucerne and soybeans dried according to various methods were examined. So we could also investigate whether the different methods of curing or conservation do influence and to what extent, directly or indirectly the protein and fibre content of the roughages referred to.

Finally we endeavoured to find out whether the protein: fibre ration in the various roughages and their percentage in the dry matter was similar or how far it differed.

Experimental Method

Analyses were carried out according to the laboratory methods adapted by this Institute.

For protein determination the nitrogen determination method of KJELDAHL was used; the raw fibre was established according to Henneberg and Stohmann while the dry matter by weighing the air dry lucerne at 105° C after 3 hours of drying and converting the figures thus obtained to absolute dry matter. Carotene analyses were carried out with a non published but generally used and well working column chromatographic method which had been introduced in this Institute by Mrs. DÖRNER.

According to the results of the 424 analyses: raw protein content fluctuated between 7.2 and 28.3 per cent and was 16.65 per cent on the average; raw fibre content fluctuated between 17.3 and 37.6 per cent and was 24.59 per cent on the average.

The data of the Table were evaluated with the co-operation of the Mathematical Institute of the Hungarian Academy of Sciences using the methods of analysis of variance, regression and correlation calculation. The results of this evaluation are presented in the Tables below.

Table 1

Lucerne analyses as related to dry matter

Year	Region	Raw protein %	Raw fibre %	Total %	Raw protein %	Raw fibre %	Total %
1955	Great Hung.	Dried with air current			Windrow-dried		
	Plain (Alföld)	21.4	19.9	41.3	19.4	24.0	43.4
		14.3	28.0	42.3	12.8	29.3	42.1
		19.1	21.5	40.6	10.3	29.3	39.6
		19.6	27.0	46.6	14.6	28.8	43.4
		18.9	26.2	45.1	15.1	28.3	43.4
		18.4	25.6	44.0	16.1	30.2	46.3
		21.4	18.2	39.6	13.1	28.5	41.6
		18.9	17.3	36.2	15.1	33.0	48.1
		17.6	27.0	44.6	17.9	18.8	36.7

Year	Region	Raw protein %	Raw fibre %	Total %	Raw protein %	Raw fibre %	Total %
		20.1	20.3	40.4	16.1	22.6	38.7
		19.9	19.8	39.7	16.6	23.2	39.8
		19.3	21.0	40.3	19.6	23.3	42.9
		18.6	25.7	44.3	18.7	22.4	41.1
		19.1	24.1	43.2	19.7	23.1	42.8
		21.6	20.9	42.5	21.7	26.2	47.9
		24.7	21.7	46.4	23.7	22.5	46.2
		21.8	24.9	46.7			
		26.9	20.5	47.4			
		24.7	21.5	46.2			
	Transdanubia	14.6	24.0	38.6	12.8	29.3	42.1
		20.6	21.4	42.0	18.2	20.1	38.3
		18.9	24.4	43.3	17.1	31.8	48.9
		21.0	20.4	41.4	18.8	21.6	40.4
		19.7	23.5	43.2	15.3	26.2	41.5
		20.8	27.5	48.3	17.5	26.1	43.6
		21.7	22.4	44.1	18.0	27.5	45.5
		18.6	30.0	48.6	16.2	32.0	48.2
		19.2	26.6	45.8	16.4	28.1	44.5
		18.6	26.1	44.7	12.5	33.1	45.6
		15.0	30.4	45.4	10.1	32.8	42.9
		24.7	18.7	43.4	21.2	30.0	51.2
	North	19.1	21.0	40.1	16.1	22.2	38.3
		18.1	24.8	42.9	20.1	17.2	37.3
		21.4	18.0	39.4	14.9	30.1	45.0
		19.8	25.0	44.8			
1955	Region between the	14.6	30.0	44.6	13.1	28.1	41.2
	Danube and Tisza	19.9	21.1	41.0	16.7	22.7	39.4
	rivers	19.0	25.0	44.0	19.4	26.7	46.1
		23.7	18.8	42.5	17.6	27.0	44.6

Table 2

Lucerne analyses as related to dry matter

Year	Region	Raw protein %	Raw fibre %	Tota %	Raw protein %	Raw fibre %	Total %
1955	Region between the	Dried with air current			Windrow-dried		
	Danube and Tisza	21.4	22.4	43.8	17.6	25.6	43.2
	rivers	21.6	23.5	45.1	18.0	25.8	43.8
		20.1	24.9	45.0	19.6	25.8	45.4
		20.9	25.6	46.5	19.7	28.3	48.0
		23.0	21.5	44.5	12.9	32.7	45.6
		23.2	24.4	47.6	18.0	25.4	43.4
		23.7	21.0	44.7	13.8	26.7	41.5
		19.6	21.2	40.8			
		14.4	32.4	46.8			
		22.3	21.5	43.8			
		23.2	21.3	44.5			
1956	Great Hung.	19.2	27.0	46.2	18.2	27.4	45.6
	Plain (Alföld)	15.8	24.6	40.4	16.6	28.8	45.4
		23.8	22.1	45.9	21.2	26.4	47.6
		20.4	25.4	45.8	23.3	25.0	48.3
		18.4	23.5	41.9	14.8	24.4	39.2
		23.2	24.1	27.3	16.3	28.9	45.2
		22.9	20.4	44.3	21.1	19.4	40.5
		22.0	21.8	43.8	20.5	21.5	42.0
		21.4	27.0	48.4	18.2	25.5	43.7
		20.9	26.0	46.9	18.4	28.0	46.4
		21.4	25.1	46.5	18.2	25.5	43.7
		20.9	26.0	46.9	18.4	25.7	44.1
		17.7	23.3	41.0	15.7	25.9	41.6
		23.8	22.1	45.9	21.2	26.4	47.6
		19.2	27.2	46.4	21.2	26.4	47.6
		15.8	24.6	40.4	18.2	27.4	45.6
		20.4	25.4	45.8	16.0	29.5	45.5
		23.3	24.3	47.6	14.8	24.4	39.2
		18.4	23.5	41.9	21.1	19.4	40.5
		23.9	20.4	44.3			
		22.0	21.8	43.8			
		21.4	25.1	46.5			
		23.8	23.0	46.8			
		21.1	23.7	44.8			

Year	Region	Raw protein %	Raw fibre %	Total %	Raw protein %	Raw fibre %	Total %
1956	Transdanubia	20.8	26.0	46.8	14.5	30.4	44.9
		15.3	27.8	43.1	15.7	25.9	41.6
		21.2	24.5	45.7	19.3	25.0	44.3
		20.3	24.2	44.5	19.0	28.0	47.0
		17.7	23.3	41.0	20.0	28.0	48.0
		18.8	26.5	45.3	15.7	28.7	44.4
		17.1	24.3	41.4	12.1	31.8	43.9
		21.2	26.4	47.6	19.3	25.5	44.8
		15.6	28.6	44.2	15.4	30.8	46.2
		18.9	26.9	45.8	17.3	29.2	46.5
		19.7	26.1	45.8	17.0	27.3	44.3

Table 3

Lucerne analyses as related to dry matter

Year	Region	Raw protein %	Raw fibre %	Total %	Raw protein %	Raw fibre %	Total %
		Dried with air current			Windrow-dried		
1956	Transdanubia	14.2	31.0	45.2	15.3	32.1	47.1
		16.3	30.0	46.3	20.0	28.0	48.0
		21.4	28.1	49.5	14.0	32.0	46.0
		17.0	30.0	47.0	7.2	37.6	44.8
		9.0	32.5	41.6	16.7	33.0	49.7
		16.4	27.0	43.4	17.6	30.0	47.6
		16.7	29.0	45.7	14.5	30.0	44.5
		22.6	24.0	46.6	16.7	31.7	48.4
		17.2	27.2	44.4	15.0	32.0	47.0
		20.3	28.0	48.3	21.2	25.0	46.2
		19.8	25.1	44.9	19.1	26.0	45.1
		24.7	18.7	43.4	18.1	24.9	43.0
		22.7	22.9	46.0	18.1	24.9	43.0
		20.0	26.0	46.0			
		20.3	26.0	46.3			
1956	North	16.1	30.5	46.6	11.7	33.5	45.2
		21.5	23.6	45.1	21.6	23.6	45.2

Year	Region	Raw protein %	Raw fibre %	Total %	Raw protein %	Raw fibre %	Total %
	Region between the Danube and Tisza rivers	19.1	28.0	47.1	15.1	32.1	47.2
		16.2	32.0	48.2	14.7	32.6	47.3
		21.1	23.7	44.8	19.7	23.2	42.9
		21.7	26.5	48.2	18.8	27.5	46.3
		22.4	23.7	46.1	15.8	25.8	41.6
		21.3	26.1	47.4	17.8	28.2	46.0
		21.1	24.5	45.6	19.8	26.5	46.3
		18.7	24.5	43.2	17.6	26.1	43.7
		21.1	24.5	45.6	17.0	29.0	46.0
		24.5	18.5	43.0	18.8	25.5	44.3
		23.5	16.5	40.0			
		23.8	21.2	45.0			
		21.5	19.6	41.1			
		15.0	22.8	37.8			
		14.6	27.7	42.3			
		14.6	30.1	44.7			
		22.7	15.5	38.2			
1956		18.5	24.5	43.0			
		19.4	24.4	43.8			
		22.2	24.2	46.4			
		22.4	23.7	46.1			
		22.3	23.6	45.9			
		19.8	27.2	47.0			
		20.8	24.2	45.0			
		21.3	26.1	47.4			

Table 4

Lucerne analyses as related to dry matter

Year	Region	Raw protein %	Raw fibre %	Total %	Raw protein %	Raw fibre %	Total %
1957	Great Hung.	Dried with air current			Windrow-dried		
	Plain (Alföld)	22.8	23.6	46.4	20.7	23.6	44.3
		20.8	26.0	46.8	19.5	23.0	42.5
		22.3	26.0	48.3	19.0	30.0	49.0
		23.8	23.0	46.8	21.6	25.2	46.8
		19.2	26.2	45.4	16.7	28.7	45.4
		20.6	26.8	47.4	17.8	28.6	46.4
	Transdanubia	23.8	20.0	43.8	22.3	19.0	41.3
		22.4	23.8	46.2	20.9	24.1	45.0
		22.4	26.6	49.0	18.9	27.5	46.4
		23.1	23.9	47.0	19.5	26.7	46.2
		19.4	24.4	43.8	17.8	28.4	46.2
		22.0	24.2	46.2	17.8	28.0	45.8
		22.4	23.7	46.1	19.8	27.8	47.6
		22.3	23.6	45.9	17.7	28.2	45.9
	Region between the	24.3	20.9	45.2	20.6	26.1	46.7
	Danube and Tisza	22.3	25.6	47.9	18.8	27.3	46.1
	rivers	23.1	26.3	49.4	19.4	26.5	45.9
		25.0	21.7	46.7			
		20.8	24.2	45.0			
		18.0	24.3	42.3			
1961	Great Hung.	Dried with hot air			Transdanubia dried with warm air		
	Plain (Alföld)	18.5	25.4	43.9	15.0	27.4	42.4
		12.8	39.4	52.2	14.6	27.2	41.8
		20.0	26.2	46.2	22.6	16.9	39.5
		17.5	28.0	45.5	21.1	19.6	41.4
		21.8	29.4	51.2	22.0	20.6	42.6
		18.5	30.4	48.9	21.5	21.3	42.8
		17.9	24.6	42.5	20.0	23.7	43.7
		22.6	22.1	44.7	19.8	22.6	42.4
		25.2	17.1	42.3	19.1	26.1	45.2
		20.1	19.8	39.9	18.2	23.8	42.0
		22.2	21.0	43.2	21.6	20.8	42.4
		24.4	22.7	47.1	17.9	22.2	40.1
		19.6	26.7	46.3	16.4	27.7	44.1
		21.8	23.1	44.9	19.8	22.8	42.6
		21.0	21.8	42.8	16.5	28.2	44.7
		20.0	24.2	44.2	13.4	25.3	38.7

Table 5

Lucerne analyses as related to dry matter

Year	Region	Raw protein %	Raw fibre %	Total %	Raw protein %	Raw fibre %	Total %
1961	Great Hung.	Dried with hot air			Transdanubia dried with warm air		
	Plain (Alföld)	24.6	21.7	46.3	15.9	23.2	39.1
		21.8	24.4	46.2	16.9	23.3	40.2
		20.6	24.4	45.0	15.8	22.4	38.2
		22.4	21.2	43.6	14.5	24.5	39.0
		20.9	24.0	44.9	21.5	20.4	41.9
		21.2	24.4	45.6	18.7	22.0	40.7
		24.3	21.0	45.3	22.9	20.1	43.0
		21.3	22.8	44.1	20.2	26.7	46.9
		20.9	25.8	46.7	21.0	23.4	44.4
		21.0	25.4	46.4	16.6	30.0	46.6
		28.3	16.0	44.3	18.1	29.0	47.1
		21.7	20.8	42.5	23.8	18.0	41.8
		22.1	23.2	45.3	17.6	25.4	43.0
		25.5	18.6	44.1	17.0	23.7	40.7
					22.8	19.3	42.1
					23.6	23.0	46.6
					21.5	22.0	43.5
					17.1	28.0	45.1
					16.7	24.7	41.4
					22.0	22.2	44.2
					20.6	20.4	41.0
1962		27.6	15.6	43.2	21.2	25.1	46.3
		22.6	17.0	39.6	22.5	23.0	45.5
		21.8	18.6	40.4	21.2	21.2	42.4
					20.4	20.6	41.0
		21.4	22.5	43.9	20.6	20.9	41.5
		22.6	25.4	48.0	18.0	26.1	44.1
		22.8	22.4	45.2	20.0	27.9	47.9
		21.3	22.7	44.0	21.0	24.5	45.4
		21.1	22.9	44.0	20.7	26.6	47.3
		20.0	23.8	43.8	23.6	19.5	43.1
		19.6	25.4	45.0	22.2	19.4	41.6
		25.4	17.0	42.4	23.7	21.0	44.7
		23.8	21.4	45.2	22.0	20.1	42.1

Year	Region	Raw protein %	Raw fibre %	Total %	Raw protein %	Raw fibre %	Total %
1962		24.5	19.9	44.4	23.3	20.5	43.8
		19.0	22.9	41.9	22.2	23.4	45.6
		20.2	20.7	40.9	22.5	22.5	45.0
		20.5	19.4	39.9	22.8	22.6	45.4
		16.6	31.2	47.8	21.2	24.5	45.7
		16.8	30.2	47.0	20.5	21.4	41.9
		17.2	26.5	43.7	22.6	20.1	42.7
		21.6	27.5	49.1	19.3	28.2	47.5
		26.3	20.9	47.2	19.6	21.2	40.8
		25.5	18.8	44.3	19.4	27.1	46.5
		25.7	16.8	42.5	18.4	27.9	46.3
		23.8	16.4	40.2	16.5	30.6	47.1
		24.8	18.0	42.8	16.6	30.0	46.6
		23.7	19.6	43.3	18.8	27.8	46.6
		22.8	20.4	43.2	18.2	25.7	43.9

Table 6

Lucerne analyses as related to dry matter

Year	Region	Raw protein %	Raw fibre %	Total %	Raw protein %	Raw fibre %	Total %
1962	Great Hung.	Dried with hot air			Transdanubia dried with warm air		
	Plain (Alföld)	22.8	18.4	41.2	17.5	24.6	42.1
		23.4	19.6	43.0	18.6	28.0	46.6
		21.6	17.4	39.0	17.2	21.8	39.0
		22.4	17.3	39.7	18.8	27.0	45.8
		23.2	19.5	42.7	20.2	21.6	41.8
		22.2	21.8	44.0	19.3	26.0	45.3
		23.5	20.5	44.0	19.9	26.4	46.3
		22.3	20.3	42.6	18.5	23.5	42.0
					21.7	24.9	46.6
					15.7	29.6	45.3
					20.2	24.6	44.8
					21.7	21.1	42.8
					18.1	24.4	42.5
					22.1	20.9	43.0

Year	Region	Raw protein %	Raw fibre %	Total %	Raw protein %	Raw fibre %	Total %
					22.8	22.0	44.8
					22.3	24.5	46.8
					20.4	21.6	42.0
					20.3	20.6	40.9
					21.7	19.8	41.5
					24.4	16.4	40.8
					25.6	16.0	41.6
					20.8	19.2	40.0
					22.7	21.9	44.6
					19.0	22.4	41.4
					19.8	21.4	41.2
					19.2	23.6	42.8
					17.2	25.1	42.3
					18.5	26.2	44.7
					17.2	25.6	42.8
					17.4	24.5	41.9
					18.4	24.8	43.2
					18.8	24.4	43.2
					20.4	21.0	41.4

Table 8

Analysis of variance

Year	Effect	Protein P %	Fibre P %
1955	regional unit	>20	> 5
	drying	< 0.1	< 1
1956	regional unit	< 1	< 0.1
	drying	< 0.1	< 5
1957	regional unit	>20	>20
	drying	< 0.1	< 5
1961		< 1	>60
1962		< 0.1	~ 0.1

Table 7

Mean values and standard deviations

Year	Nutrient	Method of drying	Hungarian plain			Transdanubia			North			Region between Danube and Tisza		
			n	X	s	n	X	s	n	X	s	n	X	s
1955	protein	air current	19	20.33	2.86	12	19.45	2.75	4	19.60	1.38	15	20.71	2.95
		windrow	16	16.91	3.49	12	16.18	3.09	3	17.03	2.72	11	16.95	2.55
	fibre	air current	19	22.69	3.23	12	24.62	3.65	4	22.20	3.35	15	23.64	3.63
		windrow	16	25.84	3.86	12	28.22	4.21	3	23.17	6.50	11	26.80	2.47
1956	protein	air current	24	20.92	2.45	26	18.67	3.23	2	18.80	3.82	25	20.38	2.80
		windrow	19	18.50	2.47	24	16.62	3.01	2	16.65	7.00	10	17.51	1.84
	fibre	air current	24	24.06	1.96	26	26.54	2.87	2	27.05	4.88	25	24.13	3.79
		windrow	19	25.53	2.85	24	29.08	3.24	2	28.55	7.00	10	27.65	2.94
1957	protein	air current	6	21.58	1.68	8	22.22	1.27				6	22.25	2.56
		windrow	6	19.22	1.81	8	19.34	1.85				3	19.60	0.92
	fibre	air current	6	25.27	1.56	8	23.78	1.81				6	23.83	2.13
		windrow	6	26.52	2.96	8	26.21	3.22				3	26.63	0.61
1961	protein	hot air	30	21.35	2.87	37	19.05	2.87						
	fibre	hot air	30	28.85	4.38	37	24.46	3.15						
1962	protein	hot air	35	22.30	2.55									
	warm air	hot air				61	20.25	2.14						
	fibre		35	21.11	3.88	61	23.52	3.19						

Table 9

Correlation and regression coefficients

Year	n	r	a	sa	b	Equation of regression straight $y = ax + b$
1955	92	−0.68	−0.81	0.093	39.99	$y = -0.81 \times + 39.99$
1956	132	−0.75	−0.84	0.064	42.03	$y = -0.84 \times + 42.03$
1957	37	−0.72	−0.85	0.14	42.96	$y = -0.85 \times + 42.96$
1961	67	−0.69	−0.84	0.11	40.44	$y = -0.84 \times + 40.44$
1962	96	−0.77	−1.11	0.095	45.92	$y = -1.11 \times + 45.92$

Results

The results of laboratory analyses were corroborated and supported by the results of statistical analyses.

On the strength of the above data it can be established that:

1. Between the raw protein and raw fibre contents of the papilonaceous roughages analysed there is a correlation and of the inverse direction because the higher the protein content, the lower the raw fibre content and vice versa. This is evidenced by the calculations of correlation according to which the coefficients are between 0.7 and 0.8 i.e. there is a correlation between raw fibre and raw protein contents and since these correlation coefficients are in all cases negative, with the increase of protein the values of the raw fibre content diminish.

Table 10

Points of regression straight, reliability limits of regression straight

Year	X protein fibre	15	17	20	22	25
		protein %				
1955	I.	27.78	26.15	23.71	22.08	19.64
	II.	0.90	0.68	0.67	0.88	1.33
1956	I.	29.36	27.67	25.14	23.45	20.92
	II.	0.64	0.47	0.42	0.56	0.87
1957	I.	30.17	28.45	25.91	24.21	21.65
	II.	1.72	1.21	0.62	0.67	1.31
1961	I.	27.89	26.21	23.70	22.03	19.52
	II.	1.29	0.94	0.66	0.78	1.27
1962	I.	29.29	27.07	23.75	21.53	18.24
	II.	1.14	0.77	0.24	0.24	0.77

I. points of regression straight (y).
II. half interval of the reliability of regression straight ($s_y t$)°. 05).

The r values of the years are as follows:

1955	−0.68
1956	−0.75
1957	−0.72
1961	−0.69
1962	−0.77
1962.b	−0.88

2. In lucerne the sum of raw protein + raw fibre together as related to dry matter is generally 40—45 per cent. There are years, however, when this figure approximates or, in a few cases, even attains 50 per cent, evidently depending on weather conditions or as a consequence of reasons detailed below. For verification we present the regression coefficients which are nearly identical and also the regression straights are parallel, as shown in Fig. 1.

The regression equations are

in	1955	$y =$	-0.81	$x+$	39.99
	1956		-0.84	$x+$	42.03
	1957		-0.85	$x+$	43.96
	1961		-0.84	$x+$	40.44
	1962		-1.11	$x+$	45.92

Figs. 2, 3, 4, 5 and 6 present the regression straights, with their limits of reliability at various points of protein value.

From the Figures it appears that the reliability stripe of the regression straight is narrow. From these it can be concluded that a strong correlation exists between protein and raw fibre.

The extreme cases referred to above are rather rare and can often be traced back to the fact that owing to the rainy weather the leaching out of nutrients in the hays dried on windrows was so important that it essentially changed the composition of the whole dried material and increased in all cases the relative per cent of the raw fibre. Differences in nutrient contents caused by the various methods of desiccation are also verified by the statistical analyses. The mean values relating on protein and raw fibre reveal that the method of drying gives also within each year very different results which appears not only in the mean values but also in the standard deviation.

3. The influence of regional units on the raw protein: raw fibre ratio could not be proved. According to statistical analyses the influence of regional units can be neglected. The following P % values were obtained:

1955	>20
1956	< 1
1957	>20

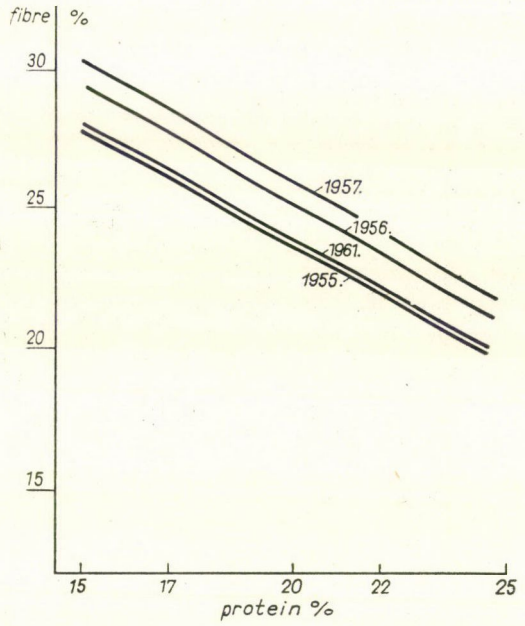

Fig. 1. **Relationship between protein and raw fibre**

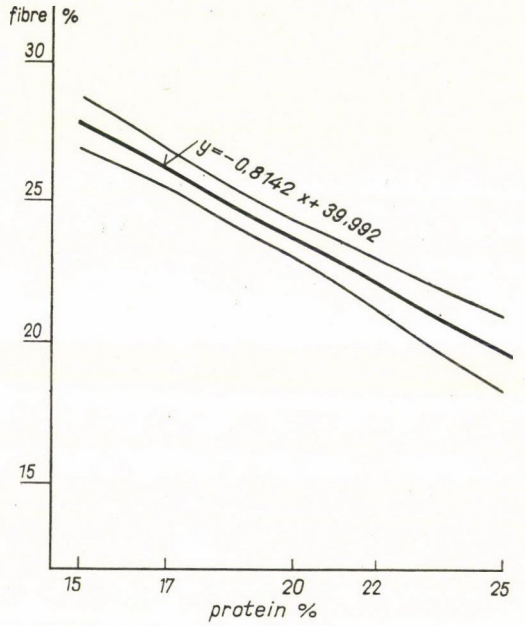

Fig. 2. **Relationship between protein and raw fibre**

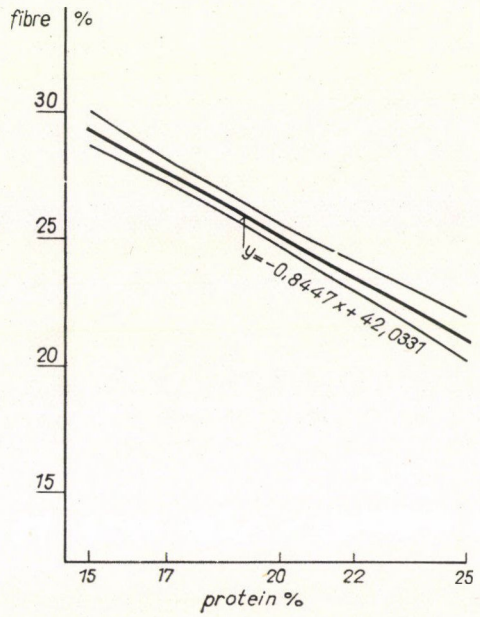

Fig. 3. **Relationship between protein and raw fibre**

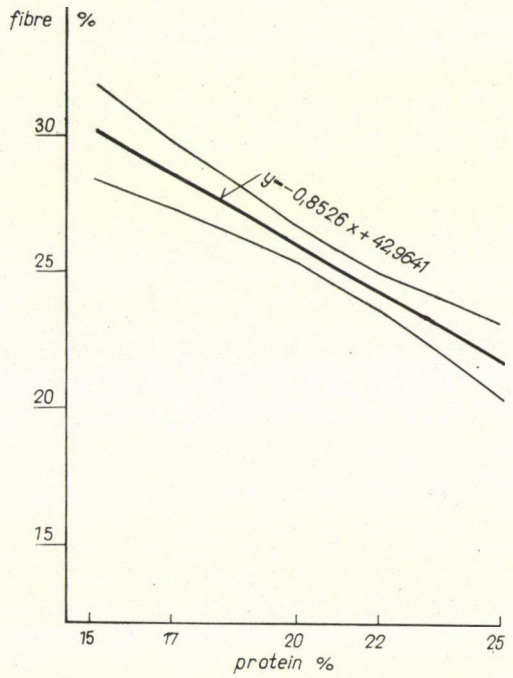

Fig. 4. **Relationship between protein and raw fibre**

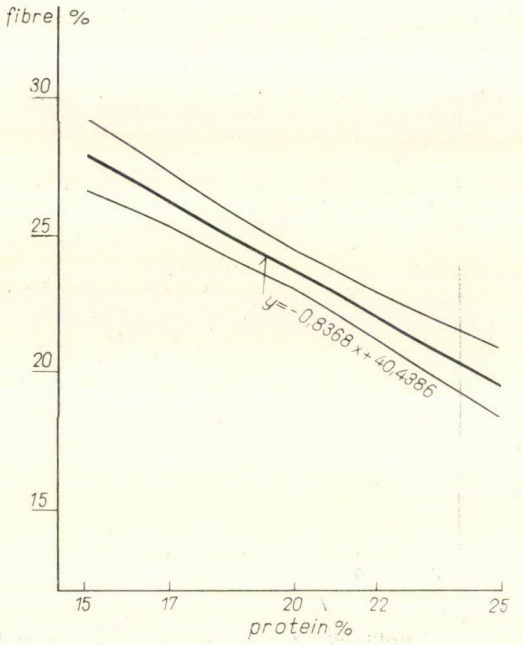

Fig. 5. Relationship between protein and raw fibre

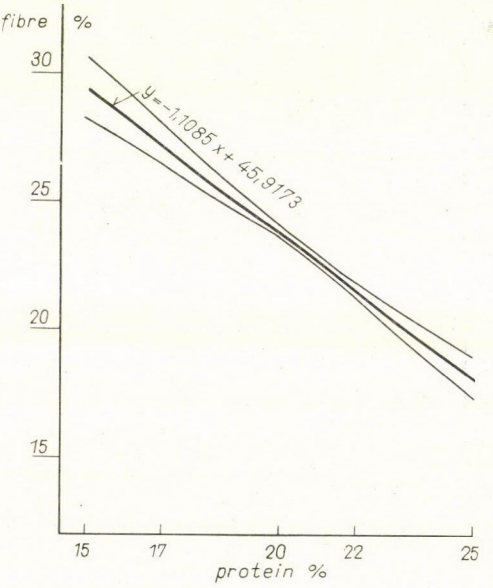

Fig. 6. Relationship between protein and raw fibre

The influence of regional units was only studied in the above 3 years because for the next years no considerable measurements were available separately from each regional unit. It were useful, however, to complete these findings with further, wider investigations.

4. Among roughages dried in different months of the same production period (May—September) no considerable differences were found in the above respect.

5. As to the methods of curing it was found that the raw fibre ratio to protein content in windrow-dried hays was generally always and the absolute content sometimes higher than in the artificially dried ones.

The difference against the normal ratio is caused by the higher grade of leaching out of nutrients depending on the weather conditions, which was frequently observed when drying the hay in windrows.

The difference against the normal nutrient content free of losses with the lucerne is caused by the fact that with artificial drying as a rule more up-to-date agricultural technology is employed. Where for instance hot air drying is carried out, there are, as a rule, more specialists of better professional training who endeavour to produce more valuable feeds and to cut the hay in an earlier developmental stage, when protein to fibre ratio is better. With the ageing of the fodder the raw fibre content increases at a higher rate than the raw protein diminishes — this is also verified by the experiments of SZENTMIHÁLYI — and this may cause the sum of the two to exceed 45 per cent of the dry matter content. In this developmental stage, however, the plant cannot be regarded as a fodder of full value since part of its leaves are fallen off and the stem is lignified.

From the Tables presented it appears that the average sum of raw protein and raw fibre content in the dry matter shows little deviation although some amplitudes are rather important. These, however, occur rather seldom.

6. Investigations were extended to soybeans cut in green condition and this was found to contain less raw fibre than lucerne. Thus, although its protein

Number of amplitudes greater than 10%

Year	Number of analyses	Units +	%	Units −	%
1955	92	7 =	7.5	5 =	5.5
1956	132	—	—	4 =	3.0
1957	37	—	—	— =	—
1961	67	4 =	6.0	2 =	3.0
1962	96	3 =	3.0	1 =	1.0
Total	424	14 =	3.2	12 =	2.8

content is somewhat lower, it can be probably well used in the feeding of poultry, the more as the biological value of its protein is high. Owing to the low number of analyses on soybeans these studies need to be continued. Still we think it proper to mention these findings on account of the high importance of soybeans in feeding.

Conclusions

Thus our examinations have proved the assumption to be correct that it is enough to determine the dry matter and raw protein content; the raw fibre content can be calculated from these data with sufficient accuracy for practical purposes.

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CONTRIBUTIONS TO THE PHARMACOBOTANICAL KNOWLEDGE OF DATURA METEL L. VAR. MURICATA (BERNH.) UNDER HUNGARIAN CONDITIONS

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After a many sided species identification and investigation the best known variant (var. *muricata* [Bernh.] Danert) of the original metel-datura was studied in Hungarian conditions. Its morphological conditions and body formation in the course of the vegetation period were examined, the total alkaloid content in each organ measured in various developmental stages exactly delimited and the developments of the alkaloid spectrum studied. The free amino acid spectrum of the plant was also investigated. Developments of the arginine, ornithine, proline, glutamic acid material groups playing a part in the biogenesis of tropane alkaloids and of phenyl-alanine were compared with the ontogenetical rhythm of alkaloid contents.

Introduction

On the ground of an erroneous practice in the Central European trade of drogues the american *Datura innoxia* Mill. had become known — under the name of *Datura metel* — and had been offered for sale in Hungary for many years. The systemic works of SAFFORD (1921) and later of DANERT (1954) called the attention to this error (SÁRKÁNY—VERZÁR-PETRI, 1957) and with further detailed morphological examinations (VERZÁR-PETRI—SÁRKÁNY, 1960) and histological and chemical analysis (VERZÁR-PETRI—SÁRKÁNY, 1961) we made a distinction between the two species in question.

In the present paper the *muricata* (Bernh.) Danert, as a variant of the *Datura metel* originating from is discussed which, according to our experience, shows the best development in Hungary.

It should be noted that this plant is not cultivated in Hungary, it is known only as a horticultural ornamental plant. — In its original habitat as well as in England and similarly to *Datura innoxia* Mill. it is known as a source of scopolamine in pharmaceutics. The Indian Datura species (*D. metel* variants) were studied in their home country by CHATERJEE—LAHIRI (1948). According to their examinations the *fastuo* of various origin contain 0.10 to 0.44 per cent alkaloid including 0.07 to 0.24 per cent hyoscyne (scopolamine) while the hyoscyamine content was 0.02 to 0.14 per cent.

HILAS and co-workers (1959) in Egypt determined the total alkaloid contents of *D. metel* at 0.43 per cent on the average while GERASIMENKO and

co-workers (1953) found the alkaloid content of *D. metel* var. *fastuosa* to be 0.45—0.71 per cent as reckoned in scopolamine.

For the alkaloids of the Indian *D. metel* some data are found in the summary of LEETE by BLAKESLEE (1957) where cuscohygrine and meteloidine are mentioned.

With new alkaloids of a number of *Datura* species EVANS—WELLENDORF (1958) have been dealing in detail, but for the time being *D. metel* L. var. *muricata* (Bernh.) Danert has not thoroughly examined yet in Hungary.

Material and Method

Comparing the nomenclature of the most important and detailed systematical work dealing with *Datura* species the following summary can be established (Table 1):

Some morphological characteristics of the developed plant can be summarized as follows:

The stem of this variant is not anthocyanic. The fluffiness of overground parts can be observed only under the magnifier. The distribution of the foliar leaf is lobate, its shape is lanceolate. The colour of the flower is white. The number of the corollar lobes is 5, the number of the corollar circles 2. The shape of the fruit is a globe deepening in at the apex. The surface of the fruit is verrucose. The shape of the seed is pyriform, its colour yellow.

The examined seed material as well as part of the living plants originate under the name of *Datura metel* L. from the Research Institute of Horticulture.

The seed material was sown in the University Botanical Garden into glass house boxes after careful raising and they were planted outdoors.

Plant material had been kept in the Botanical Garden from 1959 to 1963. The soil of the garden was examined according to the prescription in the Phytophysiological Practicum of SZALAY—FRENYÓ. Results obtained are included in Table 2.

Table 1

Comparative review of systemization in the variety Datura metel

Denomination of Linné	Denomination of Bernhardi	Index Kewensis	Denomination of Safford	Denomination of Danert	Synonyms according to Danert
D. fastuosa L. beta	*D. Humatu* var. *muricata* (Reed mal.) Bernh.	*D. alba* Nees *D. muricata* Link. = *D. fastuosa* L.	*D. metel* L.	*D. metel* L. var. *muricata* (Bernh) Danert	*D. fastuosa* L. *D. Humatu* var. *muricata* Bernh.

Table 2

Result of examination to the soil of the Botanical Garden

Moisture content	Full water capacity	Character of humus	Humus content	$CaCO_3$	pH	Granulation			
						gravel	coarse sand	fine sand	clay sediment
8%	55%	mild	5%	above 5%	6	12.75%	13.5%	31.5%	42.25%

K = little P = medium

We had indicated several developmental stages for alkaloid and amino acid examinations which were carried out in the phases I—XI. These are the following: I. = seedling with cotyledon, II. = nursling with 2 foliar leaves, III. = young plant with 3—6 foliar leaves, IV. = appearance of the first branching, V. = flower opened in the first branching, VI. — flower opened in the second branching, VII. = developed green fruit in the first branching, VIII. = developed green fruit in the second branching, IX. = ripe fruit in the first branching, X. = less than half ripe fruits, XI. = more than half ripe fruits.

In the quantitative alkaloid examinations we proceeded according to the prescriptions of the Hungarian Pharmacopoeia V., except for the extraction which we have carried out according to the prescription of BERGER (1950) with three cold chloroform shakings after preliminary exposure with ammonia. The volumetric analysis according to the Pharmacopoeia is of analytical accuracy, with an error of ± 2 per cent. The alkaloid content is expressed percentually as related to dry weight, while absolute alkaloid content was calculated for the dry weight of the plant organ examined.

Leaching through the titrate it was shaken out according to STEINEGGER's method (1952 a) with three times 20 ml chloroform and distilled until dry. At the paper chromatographic examination we used the method of ROMEIKE (1952) and worked with circular chromatograms. The sensitivity of the method is 1 micro-g hyoscyamine. In some cases we used also the ascending method proceeding according to HAIS and MAČEK (1958).

The Rf values of the alkaloids are the following:

cuscohygrin = remains in start. (With the ascending method Rf = 0.20)
hyoscyamine = 0.57
meteloidine = 0.73
scopolamine = 0.88 (with us 0.80—85)
ditigloilteloidine = 0.93

It was necessary to increase sensitivity especially in the ascending chromatograms. In these cases sulphuric acid treatment according to VÁGÚJFALVI's method (1960) was employed.

Qualitative development of the alkaloid spectrum and quantitative change of its members is indicated with 1—3 crosses (+).

In the amino acid examinations making use of the procedures of LINSKENS (1959), HAIS—MAČEK (1958) and KLEINSCHMIDT (1960) the following procedure was employed: rubbing 2 g dry matter with marine sand, hot alcoholic extraction was carried out. The bound amino acids were separated with chloroform. The free amino acid fraction was cleaned on cation exchanging Dowex synthetic resin column. The amino acid spectrum was examined with the paper chromatographic method on Schleicher—Schüll chromatographic paper marked 2043/b Mg L. A 4 : 1 : 1 mixture of butanol-glacial acetic acid-water was used as annealing agent. According to need, only in some cases, to determine more safely the components of low Rf values, 2-dimension running was performed. I. annealing agent = phenol saturated with water, II. = n. butanol—glacial acetic acid—water Partridge mixture. However, we have generally worked with the one-dimension procedure, using 2 x climatization and running. The test materials were run separately and also together in various concentrations since just the amino acids are, in the course of their paper chromatographic examination, very sensitive to concentration conditions. Their Rf values and the colour of their spots are highly changing depending on the concentration for which we have established a colour scale, compared with data found in literature. Identification was always carried out shortly after development. For development the acetonic solution of 0.2 per cent ninhydrin reagent was used acidified with 2 per cent glacial acetic acid. The spots being of various colours were developed at 80° C for 15 minutes. In a violet shade appeared glutamic acid, phenyl-alanine, alanine, arginine, ornithine, valine. Violet-gray were cystine and cysteine, tyrosine, treonine and tryptophane. With a gray colour came forth histidine and methionine; yellow was the proline, orange was the oxyproline, glycine and lysine were red, violet-reddish-brown were serine, beta-alanine and asparagine. On the strength of the shade and spot size comparative semi-quantitative estimation was carried out with scores from 1 to 5. For some amino acids specific colour reaction was employed. Thus tryptophane was also developed with para-dimethyl-benzaldehyde, treonine with Nesler reagent, arginine with nitroprusid sodium and beta alanine with isatine.

The results published contain the mean data of 2—3 parallel examinations of homogenized mass samples originating from 5 plants each both in the alkaloid and amino acid examinations. On the basis of our measurements we determined the total alkaloid content in per cent

(relative alkaloid content) and as related to the weight of the plant organ in mg (absolute alkaloid content).

For alkaloid tests, material was collected in 1961—62, for amino acid tests, in 1962. Evolutionary morphological characteristics of *Datura metel* L. var. *muricata* (Bernh.) Danert.

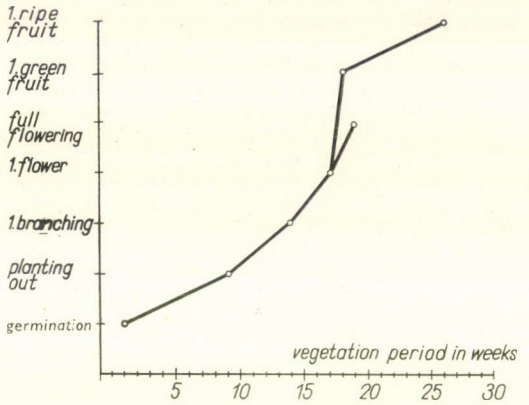

Fig. 1. Informative phenological data of *Datura metel* L. var. *muricata* (Bernh.) Danert

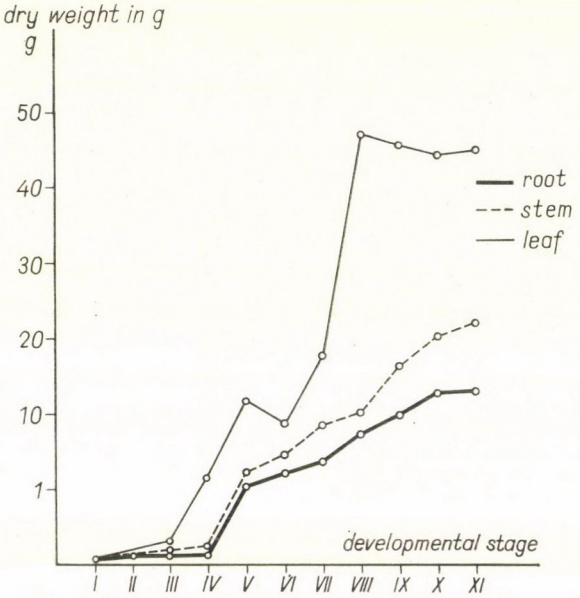

Fig. 2. Formation of dry weight in *Datura metel* L. var. *muricata* (Bernh.) Danert during ontogeny

Evolutionary morphological data of the investigated plant (Fig. 1) were compared with the other *metel* var. and with the *Datura stramonium* L. varieties and *Datura innoxia* Mill. (VERZÁR-PETRI—SÁRKÁNY, 1960).

Among *metel* varieties this plant is a variant of shortest period of emergence after var. *fastuosa*. Its first branching appears at the earliest date, which, however, occurs 4 to 6 weeks later as compared to the *D. stramonium* varieties while a shift of 3 to 7 weeks is found as compared to *D. innoxia*. At the beginning of flowering the phenological shift still increases: it can

Table 3

Developments of dry weight of Datura metel L. var. muricata (Bernh.) Danert during ontogeny

Developmental stage	Dry weight mg				
	root	stem	leaf	repro-ductive	whole plant
I.	0.003	0.002	0.004	—	0.009
II.	0.004	0.006	0.025	—	0.033
III.	0.018	0.022	0.13	—	0.170
IV.	0.21	0.24	1.35	0.19	1.94
V.	1.80	3.50	12.50	—	18.0
VI.	2.00	4.20	8.85	1.25	16.1
VII.	4.50	8.30	18.0	2.70	33.50
VIII.	7.1	10.90	47.00	4.56	69.56
IX.	10.4	16.50	46.00	5.20	78.1
X.	13.20	21.10	44.00	8.50	86.80
XI.	13.00	22.50	45.40	6.20	87.10

be estimated to 7—8 weeks. Also as related to *D. innoxia* it increases to 4 weeks. Of the other *metel* variants similar behaviour is found as in var. *fastuosa* and var. *obscura*. The entire plant is not ripening. It carries its first ripe fruit after 27 weeks which practically means the ninth of October if seeding is carried out in the glasshouse in the month of March. Of the *D. metel* varieties only part of the 3 early ones grows ripe. In these cases the plant lags behind the earliest *stramonium* variety (var. tatula) by 16 weeks, behind *D. innoxia* by 6 weeks.

Mean height of the plant is under our conditions 50—70 cm. Height of the main stem is 19—20 cm on the average, width of the main stem almost 2 cm. Dimensions of the foliar leaf (length to width ratio in cm) was 14/12 on the average. Number of average branchings per plant is 40—44, leaf number about 200.

Developments of the dry weight of the plant were measured for each organ in the 11 evolutionary morphological stages chosen for alkaloid examinations. Developments of dry weight are demonstrated on the average of 10 plants each in Table 3 and Fig. 2. (Maximum deviation among the parallels: 3.2 per cent in roots, 6.5 per cent in stem, 5 per cent in leaves.)

In the development of the dry weight beside the relative continuous rise in some morphological stages a definite sudden standstill and subsequently slow further body increase is found. So e.g. the growth (weight increase) of the root between the 5th and 6th stages comes to a standstill; similarly in stages 10 and 11. In the developments of the dry weight of the foliar leaf this standstill is observed already from the 8th stage on. In fact, this phenomenon occurs in September and is accompanied by gradual drying and falling off the foliage.

Results

Developments of alkaloid contents and alkaloid spectrum of Datura metel L. var. muricata (Bernh.) Danert in the course of ontogeny

Total alkaloid content of var. *muricata* in the root is generally high. It attains 0.85—0.74 per cent in the V. and 0.74—0.84 per cent in the VIII. developmental stage. Minima occur three times, in the IV. VII. and X. devel-

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Table 4

Developments of the alkaloid content of Datura metel L. var. muricata (Bernh.) Danert during ontogeny

Developmental stage	root		stem			leaf				flower-fruit	
	Total alkaloid content in %		Abs. alk. in mg.	Total alkaloid content in %		Abs. alk. in mg.	Total alkaloid content in %		Abs. alk. in mg.	Total alkaloid content in %	Abs. alk. in mg.
	I. year	II. year	II. year	I. year	II. year	II. year	I. year	II. year	II. year	II. year	II. year
I.	0.395	0.404	0.012	0.154	0.246	0.005	0.105	0.240	0.009		
II.	0.402	0.425	0.017	0.265	0.260	0.02	0.124	0.130	0.03		
III.	0.434	0.430	0.08	0.323	0.373	0.08	0.131	0.160	0.21		
IV.	0.204	0.225	0.47	0.113	0.202	0.48	0.446	0.480	6.48		
V.	0.867	0.743	14.86	0.445	0.480	16.80	0.149	0.155	19.38	0.362	
VI.	0.498	0.500	9.00	0.147	0.450	18.9	0.115	0.123	10.89		
VII.	0.269	0.346	15.57	0.126	0.150	12.45	0.466	0.364	65.52		
VIII.	0.746	0.845	59.99	0.139	0.142	15.48	0.334	0.282	132.54		
IX.	0.486	0.462	48.05	0.436	0.380	62.70	0.156	0.234	107.64	0.543	28.24
X.	0.078	0.184	24.29	0.925	0.750	158.25	0.415	0.362	159.28		
XI.	0.124	0.205	26.65	0.763	0.502	112.95	0.394	0.450	204.30	0.435	26.97

opmental stages. The absolute alkaloid content of the root closely follows the developments of the percentual alkaloid content (relative alkaloid content) except for the VI. and VII. developmental stage when the two features are not in agreement (Table 4). Generally the developments of the alkaloid content of the root during ontogeny presents a totally unbalanced picture with very intensive fluctuations (Fig. 3).

Total alkaloid content is also fluctuating in the stem and runs only in the beginning parallel with the root. After flowering it deviates and runs the opposite way. Between the results of the two years examined in the IV.

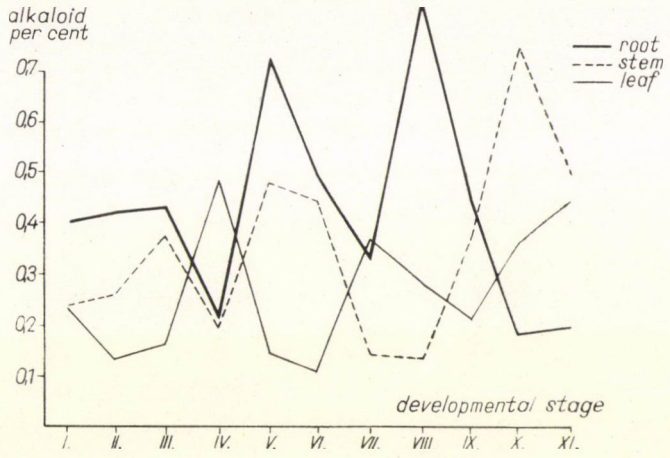

Fig. 3. Developments of total alkaloid content in *Datura metel* L. var. *muricata* (Bernh.) Danert in the vegetative organs during ontogeny (II. experimental year). 1962

stage a considerable deviation is found. In the other developmental stages, except for minor differences, the diagrams of the alkaloid contents of the two years are similar. The absolute alkaloid content in the stem is very high, in the X. developmental stage it is 158 mg (maximum).

In the leaf the total alkaloid content expressed in per cent is lower as compared to the other vegetative organs. Here, too, intensive fluctuations can be observed. Three maxima develop in the III. IV. and XI. developmental stages. The maxima are opposite to the root maxima. In the leaf the highest alkaloid contents are found in the IV. stage (0.48 and 0.44 per cent), in the VII. stage (0.46—0.36 per cent), in the X. stage (0.41—0.36 per cent) and in the IX. stage (0.39—0.45 per cent). The absolute alkaloid content of the leaf attains 204 mg (XI. stage). It increases continuously, showing a minor break only between the VIII. and IX. stage.

Percentual alkaloid contents of flower and fruit are high but the absolute alkaloid content is less. The alkaloid content of the seed is 0.45 per cent.

Table 5

Developments of the alkaloid spectrum of Datura metel L. var. muricata (Bernh.) Danert during ontogeny

Developmental stage	Organ	Cuscohygrine	Unknown. alk. I.	Unknown alk. II.	Hyoscyamine	Meteloidine	Scopolamine	7 OH, 3—6 Ditigloil teloidine
I.	root	(+)			++		+++	
	stem				++		+++	
	leaf				++		+++	
III.	root	++			+++	+	+++	
	stem		+	+	+++	+	++	
	leaf		+	+	++	+	+++	++
V.	root	++			+++	+	++++	+
	stem				++	++	++++	
	leaf				+	++	+++	+
VI.	root	+	(+)	(+)	++		++	
	stem				+++		++	
	leaf	+	+	+		++	+++	
VII.	root	++	+	(+)	+++	+	++++	++
	stem				++	++	+	
	leaf		+		++	++	+++	
VIII.	root	++	+	+	++	+	++	+
	stem	+	++	+	++		+++	
	leaf	+			++	+	+++	+
IX.	root	++			+++		++	+
	stem	+			++	+	+	
	leaf				+++	+++	(+)	+

Developments of the alkaloid spectrum were studied in the course of ontogeny on 7 occasions, in developmental stages I, III, V, VI, VII, VIII and IX and the occurrence of the various alkaloids was marked with +, taking into consideration the spot size and/or colour intensity (Table 5). In the roots of seedlings cuscohygrine could be demonstrated in traces, while hyoscyanine in medium and scopolamine in somewhat higher amounts. The alkaloids referred to are found in all organs, together with, in some cases, ditigloilteloidine and the unknown alkaloids I, II. Generally we succeeded in demonstrating from the alkaloid spectrum with paper chromatographic tests the components which were found in the *Datura stramonium* L. varieties, the *Datura meteloides* Dun. and *Datura innoxia* Mill. in the various organs, in different developmental stages (VERZÁR-PETRI 1965a).

In the III. stage cuscohygrine content rises in the root and from this point can be demonstrated during ontogeny until the IX. developmental

stage. In the stem it appears only in the 6th stage while in the leaf it can be demonstrated already in stage V. In the stages VII and IX it is missing while it is present intermediarily in stage VIII. The 2 unknown alkaloids appear in small amounts at the same time in the leaf in the III. developmental stage. They are missing in the stages V, VIII and IX, reappearing again together in VI. In the VIII. developmental stage only the unknown alkaloid I (Rf 0.27) is present. Hyoscyamine could not be always demonstrated in all organs. It is missing e.g. in the VI. developmental stage from the leaf and in some stages is present in a higher amount than scopolamine, e.g. in the VI. stage in the stem and in stage IX in the root.

Meteloidine in the developmental stage I was not present in either organ while it could be demonstrated in all organs in the developmental stages III, V and VII. In the stages VI and IX it was missing from the root or stem, respectively and in stage VIII both from stem and leaf.

Scopolamine could be demonstrated in all examined developmental stages except in stage IX (developed plant with ripe fruit, in the first branching). In this stage it is missing from the leaf or is present only in traces. So in this developmental stage the alkaloid spectrum of leaf consists solely of hyoscyamine and meteloidine. Owing to the lack of a sufficient amount of plant material we could not satisfactorily study the other *metel* varieties during ontogeny and investigate whether in what we had found during our earlier tests only hyoscyamine and meteloidine at the foliar leaf in developed stage these, in earlier age contained really those two alkaloids only or this phenomenon was an intermittent condition arising during ontogeny. — The meteloidine spots were eluted one by one and subjected to the Vitali-Morin reaction. No violet colouring was obtained which verifies a meteloidine as against hyoscyanine and scopolamine.

7 OH, 3—6 Ditigloilteloidine is continuously present in leaf. It is in every case missing from stem and can be demonstrated in root during the developmental stages III, V, VII, VIII and IX in varying amounts.

The study of the alkaloid spectrum of *Datura metel* L. var. *muricata* supplies an illuminating example of the fact that it is necessary to observe continually the plants during ontogeny to obtain a realistic picture of the alkaloid spectrum and of the alkaloid type of plant. (The plants are seen on Figs. 4, 5 and 6.)

Comparing our results of alkaloid investigations with those of similar character conducted on some practically significant *Datura* species (VERZÁR-PETRI 1965) it can be established that *Datura metel* L. var. *muricata* (Bernh.) Danert has — except for one minimum each — an alkaloid content higher than any of the *Datura* examined when considering the whole of ontogeny. This is expressed also in relative alkaloid content, but particularly in the absolute one from the VIII. developmental stage. Vegetation period and fruit ripen-

Fig. 4. Datura metel L. var. *muricata* (Bernh.) Danert in the V. developmental stage

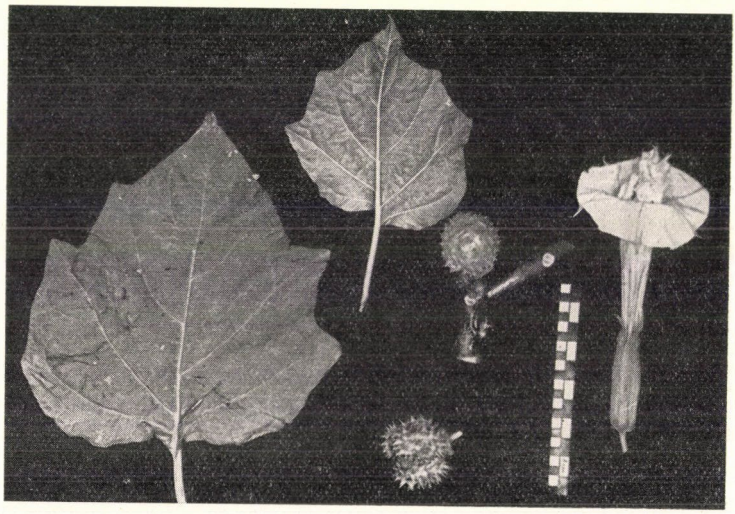

Fig. 5. Characteristic organs of *Datura metel* L. var. *muricata* (Bernh.) Danert

ing of plant, however, is very much protracted. Raising is much more costly owing to the necessity of planting out. Therefore it cannot replace as yet the more readily growing *Datura innoxia* as a possible pharmaceutical raw material

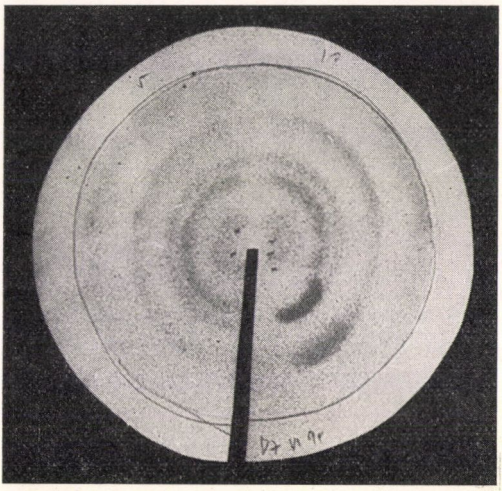

Fig. 6. Alkaloid chromatogram from the root of *Datura metel* L. var. *muricata* (Bernh.) Danert in the VI. developmental stage. In the right lower part are two alkaloid standards. (Hy, Scop.)

source. However, it were worth while dealing with its acclimatization and cultivation since the developed plant contains from the beginning of fruit ripening comparatively evenly tropane skeleton alkaloids in higher amounts (Table 4).

Developments of amino acid spectrum of Datura metel L. var. (Bernh.) Danert during ontogeny

In the plant examined the following amino acids were found: cystine and cysteine, histidine, lysine, ornithine, arginine, asparagine, serine, glycine, glutamic acid, oxiproline, alanine, proline, threonine, tyrosine, tryptophane, valine, methionine, phenyl-alanine, isoleucine and leucine.

Of plant organs in young age the richest amino acid spectrum is found in the root, then, from flowering in the leaf. In the stem and the reproductive organs, depending on the developmental stage, the composition of amino acids is highly varying.

Of the amino acids, serine, glutamic acid and alanine are present in highest quantities. The most of the above listed amino acids is generally found in all plants of higher category. The occurrence of the following is less frequent: ornithine, proline, oxiproline, β-alanine. These amino acids complete characteristically the amino acid spectrum of *D. metel* L. var. *muricata* (Table 6).

Table 6

Developments of the free amino acid spectrum in vegetative organs of Datura metel L. var muricata (Bernh.) Danert during ontogeny

Plant organ	Developmental stage	Ornithine	Lysine	Cystine-Cysteine	Arginine	Asparagine	Glycine Serine	Glutamic acid	Threonine	Alanine	Proline	Tyrosine	Tryptophane	Methionine	Valine	Phenyl-alanine	Leucine	Oxyproline	β-Alanine
root	II.	2	—	1	—	2	—	2	—	1	2	—	—	—	2	—	—	—	—
	III.	1	—	1	2	1	—	2	—	1	2	—	—	—	—	—	—	—	—
	IV.	—	—	—	2	3	2	3	—	4	2	1	—	—	—	—	—	—	—
	VI.	1	1	—	1	—	1	2	—	3	2	—	1	—	—	—	—	—	4
	VIII.	2	1	—	2	3	4	3	—	3	1	—	—	—	—	—	—	1	—
stem	II.	2	—	—	—	4	—	2	—	2	—	—	—	—	—	—	—	—	—
	III.	1	—	—	1	3	4	3	—	2	1	—	1	—	—	1	—	—	—
	IV.	4	2	—	—	4	—	3	—	3	3	—	—	—	—	—	—	—	—
	VI.	2	1	—	—	3	2	2	—	5	2	1	—	—	—	—	1	1	1
	VIII.	—	1	—	1	1	3	2	1	1	—	—	—	—	—	—	—	—	—
leaf	II.	3	—	—	—	2	—	1	—	3	4	—	2	—	1	—	1	—	—
	III.	3	—	—	—	1	3	1	—	3	5	—	2	—	2	—	1	1	1
	IV.	2	2	—	—	3	4	4	—	3	3	—	2	—	—	—	—	—	—
	VI.	2	1	—	—	1	5	5	—	5	2	3	3	—	3	—	2	—	—
	VIII.	1	1	—	1	3	4	1	4	2	—	1	1	1	2	—	1	1	—

A number of radioactive examination data are already available for the biogenesis of tropane alkaloids, if not exactly in *D. metel* var. *muricata*. Incorporation of 14 C ornithine into *D. stramonium* was verified by LEETE—MARION and SPENCER (1954) in the tropane skeleton.

JINDRA and co-workers (1959—60) pointed to the role of the ornithine-putrescine-proline-glutamic acid material group in the synthesis of tropane alkaloids while the investigations of LEETE (1960) elucidated the development of tropic acid from phenyl-alanine.

The amino acids referred to could be also demonstrated in the amino acid spectrum of *D. metel* var. *muricata* and though their correlative change is not so explicit as related to alkaloid content as in the other *Datura* species investigated by us (G. VERZÁR-PETRI 1966) they are undoubtedly present in smaller or larger amounts in the ontogenic stages, thus they can participate in alkaloid biosynthesis.

Acknowledgements

Thanks are due to Prof. S. SÁRKÁNY for his valuable suggestions, to research worker ANDRÁSFALVY for some plant specimens received, to gardeners SZÜCS, KAPOSVÁRI and BURGER for having raised the plant material from seed and to laboratory assistants Mrs. BATIZ and Mrs. PERGER for their conscientious help.

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INVESTIGATION OF THE BIOLOGICAL VALUE OF WINTER WHEAT SEEDS HARVESTED AT VARIOUS DATES

By

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In summer 1965 from three winter wheat varieties *(Besostaya 1, Karcagi 344* and *Karcagi 522)* a week after earing and then in every four days again ears had been collected until harvesting to determine the biological value of seeds harvested at various dates. According to examinations the seeds of *Besostaya 1* and *Karcagi 344* germinated already at a thousand grain weight of 3.41 or 3.78, respectively to 75 and 86 per cent while *Karcagi 522* did not germinate yet at 3.53 g. The examined varieties attained three weeks before full ripening their complete biological maturation.

Introduction

Values of seed quality appear — according to VIRÁGH (1963) — in the morphological, material and biological changes of wheat grains. Therefore the period of harvest and after-ripening is an important factor in the harvesting of cereals. According to PAPP (1953—56) the developmental period of wheat grain from flowering to end of maturation amounts to 47—55 days depending on the year. The phases of maturation processes are difficult to separate from each other and their duration is related to environmental factors and depends also on variety and on a number of other factors.

Maturation of seeds and fruit as stated by WIAZECKA (1963) consists not only of accumulation of nutrients and of deviation in the dimensions characteristic of the given species, but depends first of all on many biochemical transformations manifesting themselves sometimes also in morphological changes.

Many workers were interested in the problem of the biological value of immature seeds and not only from theoretical but from practical viewpoint as well. In this retion the objective of most studies was the seedling vigour and germinative capacity of immature maize kernels (WALKER 1936, SPRAGUE 1936, CULPEPPER—MOON 1941).

SERGEEV—KUCHEROV (1957) attracted the attention to the proper storage of immature seeds. They established that maize stored in a flask generally showed 84 per cent germination even if harvesting occurred before full maturation.

A number of research workers were engaged in the examination of immature grains of cereals, among others NUTMAN (1941), HATCHER—PURVIS

(1945) who in their studies demonstrated that immature cereal grains the weight of which was no more than 1/6 or 1/10 of the normally developed seeds were of perfectly good viability.

HATCHER—PURVIS (1945) examined the after-effect of immature wheat grains on development and yield of plants. They found that growth, leaf formation and tillering of plants originating from immature grains was better but subsequently the differences became indistinct.

In the wet zones of the Ukraine winter wheat is only too often harvested in a physiologically immature condition and generally shows a poor germination. Therefore according to KOLESNIK (1953) the seeds are dried on the sun heat or in thermic way before seeding. With such methods seedling vigour may increase to the 7—8 fold and the developmental stage of seedling (on the second day of growth) may attain 2.5—3-fold.

Seeds of cereals reach very soon their physiological maturity and produce progeny of good size with qualitatively and quantitatively well developing progeny (WIAZECKA 1963).

Material and Method

In 1965 examinations were conducted at Karcag, in the Institute for Agricultural Experiments of Great Cumania. In the experiment the Soviet variety *Besostaya 1* and the Hungarian winter wheat varieties *Karcagi 344* and *Karcagi 522* were involved. The plots of the varieties were sown at a row distance of 12 cm with 60 seeds per running metre. The first ears were harvested 8 days (June 3) after the onset of earing (May 26). From this date further on we collected samples every 4th day until July 12, i.e. until full ripening. This was conducted as follows: every 4th day from all of varieties the most developed 5 ears were selected and cut with a 60 cm culm. Ears were bound together and hung in a well aerated storage room. Threshing of the ears and elaboration of the material was carried out at the end of July. The seeds harvested at various dates were sown in boxes on October 25 and raised in glasshouse. The experiment was established with 3 replications, with 20 seeds per treatment in every replication. After emergence the germination per cent, the seedling vigour and the growth rhythm of plants were examined.

Results

Our investigation had the objectives of determining after earing the date of physiological maturity of wheat varieties, germination per cent and vigour of emergence of the earlier harvested seeds and the growth of vegetation. If these data turn out to be favourable then harvesting can be started — even in case of unfavourable weather conditions drought or excess of precipitation — at an earlier date.

Wheat harvested earlier than in waxen ripeness has to pass through a certain after-ripening which can be completely varranted by harvesting in two operations.

Germination per cent and thousand grain weight examinations. Earing began in the three examined wheat varieties *(Besostaya 1, Karcagi 344* and *Karcagi 522)* at the same date, so harvesting of ears was carried out at the

Table 1

Developments of thousand grain weight and germination per cent of winter wheat varieties harvested at various dates Karcag, 1965

Harvesting date	*Besostaya 1.*				*Karcagi 344.*							
	Number of grains (units)	Grain weight (g)	Thousand grain weight (g)	Germination %	Number of grains (units)	Grain weight (g)	Thousand grain weight (g)	Germination %	Number of grains (units)	Grain weight (g)	Thousand grain weight (g)	Germination %
VI, 3	191	0.24	1.30	—	112	0.03	0.27	—	167	0.08	0.48	—
VI, 7	170	0.58	3.41	75	158	0.11	0.69	—	157	0.21	1.34	—
VI, 11	167	1.73	10.35	97	148	0.56	3.78	83	167	0.59	3.53	—
VI, 15	152	1.95	12.83	83	218	1.11	5.09	90	196	1.94	9.89	90
VI, 19	153	2.72	17.80	80	214	1.94	9.06	95	228	2.84	12.48	95
VI, 23	193	4.11	21.18	95	180	2.85	15.83	100	212	3.78	17.84	93
VI, 27	180	6.77	37.60	92	209	5.63	26.93	100	237	7.79	32.81	98
VII, 1	178	7.25	40.60	100	200	5.93	29.65	100	172	6.33	36.92	97
VII, 5	188	8.09	43.01	98	189	7.09	37.51	98	165	7.65	46.40	97
VII, 9	173	8.44	48.67	92	175	6.58	37.60	97	192	9.54	49.51	100
VII, 12	169	8.08	47.82	100	202	8.08	40.00	98	188	9.02	48.00	95

same time. The first date, June 3, as appears from Table 1 proved to be too early. Wheat grains were still in the initial stage of physiological maturity, i.e. uncapable of germination. Wheat grains harvested at the second date (June 7) — two weeks after earing — germinated to 75 per cent in *Besostaya 1*. In the winter wheat *Karcagi 344* the grains harvested June 11 while in the variety *Karcagi 522* the grains harvested on June 15 germinated to 83 or 90 per cent, respectively.

In the varieties *Besostaya 1* and *Karcagi 344* — as it appears from Table 1 — the germination per cent was already very good with a thousand grain weight of 3.41 or 3.78 g, respectively while in *Karcagi 522* the seed began

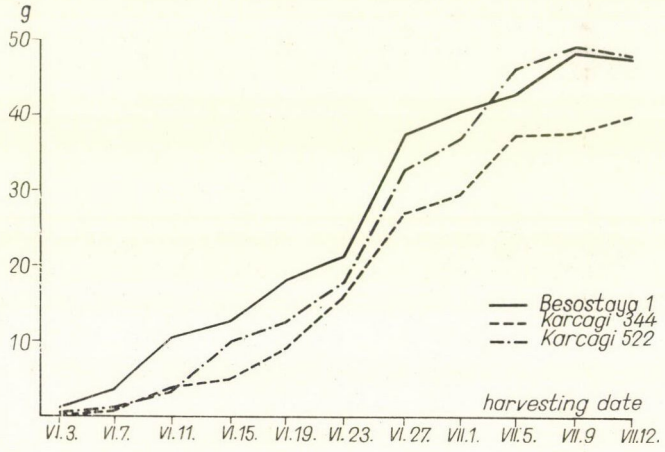

Fig. 1. Developments of thousand grain weight in the examined winter wheat varietie

to germinate at a thousand grain weight of 9.89 g. From a thousand grain weight of 10 g upwards the germination per cent increased in the examined varieties and can be practically taken for 100 per cent. It appears that harvesting — according to our examinations — might have begun with all three varieties on June 23, although total maturation ensued only 3 weeks later, on July 12.

Developments of thousand grain weight — which can be represented in Hungary with an inflexion diagram — is shown in Fig. 1. It appears that increase in grain weight is uniform in all three varieties. In two varieties— *Besostaya 1* and *Karcagi 522* — there is a minor quantitative reduction at the July 12 harvest as compared with that of July 9, which amounts to 1.25 g in *Besostaya 1* and 1.51 g in *Karcagi 522*. In *Karcagi 344* an increase of 2.40 g was observed still in this period.

Toward the end of the total maturation the grain increase in *Besostaya 1* slowed down while it became more intensive in *Karcagi 522*. In *Karcagi 344* also a certain decline was observed.

Investigation of energy of emergence and growth rhythm. The seeds of the examined varieties were sown on October 25 at a depth of 3 cm in boxes. The first seedlings appeared on November 1 and by November 6 emergence was finished in all varieties. As it appears from Table 2 the emergence energy of the Soviet winter wheat variety *Besostaya 1* was best of all which is in connection with the high germination capacity. In winter wheat *Karcagi 344* the grains taken and sown out of the June 3 and 7 harvest while in *Karcagi 522* those sown out of the June 3, 7 and 11 harvests did not emerge as a result of the physiological immaturity in the seeds.

Development and growth rhythm of variety *Besostaya 1* is presented in Fig. 2. In this Figure the growth of seedlings emerging from seeds harvested in various maturation stages can be well observed. In plants emerging from seed harvested June 7 and July 12, on the 17th day after emergence, the difference in height was 10.8 cm to the benefit of the latter. Seeds harvested June 27 showed a growth by leaps and bounds from the 14th day after emergence which is readily visible on the photo. Plants emerged from seeds harvested between June 7 and 23 showed approximately identical height. These developed comparatively weaker shoots, because their thousand grain weight had been only half of the normal, consequently no sufficient nutrient reserve had been available at initial growth. The foliage of plants emerging from seeds with lower thousand grain weight showed a fresh green colour similar to the plants from seeds harvested later with higher grain weight.

Table 2

Percentual developments of energy of emergence in the examined varieties Karcag, 1965

Harvesting date	*Besostaya 1.* after seeding of the day						*Karcagi 344.* after seeding of the day						*Karcagi 522.* after seeding of the day					
	7	8	9	10	11	12	7	8	9	10	11	12	7	8	9	10	11	12
VI, 3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
VI, 7	10	38	60	60	65	75	—	—	—	—	—	—	—	—	—	—	—	—
VI, 11	18	68	93	95	95	97	2	40	67	72	78	83	—	—	—	—	—	—
VI, 15	15	68	78	80	80	83	2	47	77	82	87	90	—	38	70	80	87	90
VI, 19	2	42	67	73	75	80	3	53	90	93	93	95	5	53	80	85	95	
VI, 23	7	63	92	92	95		5	82	97	98	98	100	5	67	92	92	93	
VI, 27	15	82	88	90	92		3	82	95	97	97	100	15	62	88	98		
VII, 1	22	93	100				30	93	98	100			20	65	88	97		
VII, 5	23	85	98				37	93	95	98			37	77	93	97		
VII, 9	15	82	92				50	95	95	97			32	92	100			
VII, 11	25	93	100				42	95	97	98			43	92	95			

Fig. 2. Plants emerged from the seed of winter wheat Besostaya 1 harvested at various dates on the 17th day after emergence

Fig. 3. Plants emerged from the seed of winter wheat Karcagi 344 harvested at various dates on the 17th day after emergence

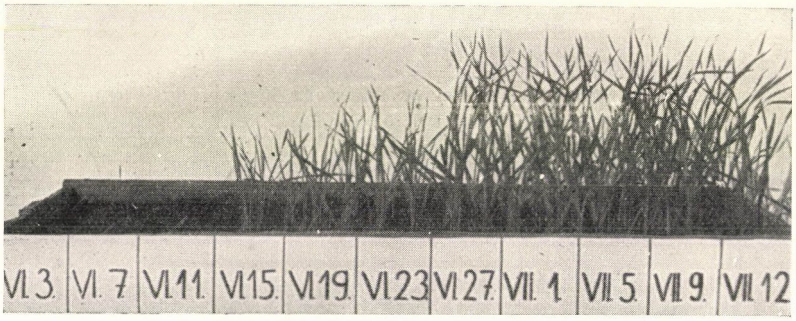

Fig. 4. Plants emerged from the seed of winter wheat Karcagi 522 harvested at various dates on the 17th day after emergence

In the winter wheat *Karcagi 344* the difference in height amounted only to 8.5 cm on the 17th day after emergence. Here the difference is lesser, as the initial development of this winter wheat variety is very slow and the growth rhythm begins to accelerate only from the period of shooting. A change in growth occurred also here in the plants that emerged from seeds harvested June 27, as represented in Fig. 3. Plants from seeds harvested between June 11 and 13 developed more poorly (thinner, stunted little plants) than from those harvested between June 27 and July 12.

The most important and vigorous growth occurred in winter wheat variety *Karcagi 522* (Fig. 4). This is a variety of very rapid development which has already germinated to 90 per cent with a thousand grain weight of 9.89 g. Although these plants were shorter by 13.4 cm. than those from seeds harvested July 9, but much more vigorous and of broader leaves than winter wheat varieties *Besostaya 1* and *Karcagi 344*. The abrupt unfolding of growth took place here from the June 27th seed as well and on the 14th day after germination. This difference can more or less be observed in all three winter wheat varieties: most conspicuously in varieties *Besostaya 1* and *Karcagi 522* and to a lesser extent in *Karcagi 344*.

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RELATIONSHIP BETWEEN FRUIT GROWTH AND FLOWERING IN MUSK MELON (CUCUMIS MELO L.)

By

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Four varieties of musk-melon have been examined from the aspect of relationship between fruit growth and flowering. Fruit growth takes place according to the sigmoid curve.

Appearance and fertilization of the first hermaphroditic flowers coincide with the initial differentiation of the hermaphroditic flowers appearing two weeks later. The rapid developmental phase of the juvenile fruit being finished the inflorescence of higher intensity i.e. the second fruit set begins at the upper point of inflexion of the sigmoid curve. From this date during one or two weeks follows the decay of the new tiny fruit; at this same time the first fruit are in the slower growth and maturation process and the hormonic level developed at that time may be the cause of the high rate of decay of fruit. After the removal of the developed fruit those remained from the second fertilization or condemned to stagnation at the time of the first fruit set undergo similar growth and developmental phases as those from the first fertilization

Introduction

On plants of unrestricted growth such as melon, cucumber and vegetable marrow the hermaphroditic and female flowers that appear first will hinder — for a certain time after fertilization — the development of further hermaphroditic and female flowers, respectively. This phenomenon is called cyclic fruit set, when during the vegetation period of plant, after a certain time new flowering and fruit set take place.

ROSA according to MCGLASSON—PRATT (1963) and WHITAKER—DAVIS (1962) established in musk melon that after the first 2—3 fruit sets no hermaphroditic flowers appeared for 2—3 weeks and subsequently at the second occasion 1—2 fruit sets occurred. MANN—ROBINSON (1960) examined anatomically and morphologically the growth of the ovaries and found that 8 days after flowering the young fruits distinguished themselves by a very rapid expansional growth and that abscission of fruits had no intrinsic morphological developmental causes. MCGLASSON—PRATT (1963) established that the fruit attained half of its full size during 40 per cent of its developmental period and they corroborated that fruit set was cyclic.

The present investigations have been carried out with the purpose of establishing the ways according to which cyclic fruit set usually occurs, further to find out what causes the drop of fruit of 3—5 cm. size and finally

we want to gain adequate morphological experience for later complex physiological-biochemical investigations. Observations were conducted in 1963 under very favourable weather conditions which appears from Fig. 1.

Material and Methods

In these experiments 3 melon varieties have been observed and compared: 2 Hungarian* and 2 Soviet varieties. Out of 10 plants per variety 4 have been selected for individual detailed examination and their individual flowering and fruit growing conditions have been represented on the Figures.

The young seedlings after sodraising in hotbeds were planted out in well developed two-leaf condition into manure hills. All varieties were of globular fruits, therefore in each case we measured on the fruit the distance between peduncle and stigma. Of the varieties, Bronzovka at the time of ripening was somewhat elongated in the direction of the axis but had been also globular in the previous phases of development. At the assessment of data the shoots of the first order were numerated, the nodi at which hermaphroditic flowers appeared, recorded and every opened flower provided with number and date. Observations were conducted between July 1 and August 26, the first three entries having been made every four days and the further ones once a week.

Some morphological characteristics

The branching of musk-melon is sympodial monochasium. On each nodus the organs are arranged as follows: between the leaf base and the adjacent tendril on a dwarfed shoot there are rudimentary bracteal hermaphroditic flower primordia of which the lowest attains a size of 5—6 (7) mm at most. Under the stereomicroscope beside the lowest in single cymose arrangement 2 more bracteal hermaphroditic flowers can be distinguished the sex of which until a size of 0.6—0.7 mm can be established with certainty. On this rudimentary shoot in none of the varieties could staminate flowers be observed.**

These rudimentary shoots decay. Behind the leaf base and the tendril somewhat at the side of the tendril arises the axis and between the two latter the group of the staminate flowers is arranged, always without bractea. After a non-regular number of nodi at the place of the staminate flowers as a rule a hermaphroditic flower appears. In very rare cases at the base of the hermaphroditic flower a rudimentary decayed staminate bud is found. The place of origin of the secondary shoot is between the axis and the leaf base. The hermaphroditic flowers of the musk-melon appear on the secondary shoots which originate at the nodi of lower number of the principal shoots.

The hermaphroditic flowers are in flower for one day, by late in the afternoon the petals begin to curl and as soon as the next day to wilt. The anthers of the Soviet varieties open between 8 and 9 o'clock in the morning while those of the Hungarian ones between 5^h 3o and 6^h 30.

Pollination is carried out by bees visiting each hermaphroditic flower 25 to 40 times. Both cross pollination and selfing equally occur. It has been observed that toward the end of the season in the variety *Magyar kincs* the pollen at the edge of the dehiscent anthers begins to germinate just when the narrow corollar tube presses the anthers to the stigma. On the day after the opening of flowers ovules and pollen tubes were examined and were found to have grown down until the apex of the ovules. The non fertilized flowers will drop in two days time.

* The variety known in trade as *Muskotály* does not seem in Hungary to be different from the melon named *Oge melon* in Holland and forced there in the glass-house.

** In similar arrangement in cucumber e.g. in the *Marketer*, *Niagara* varieties the pistillate and staminate rudimentary buds are arranged according to a mixed pattern.

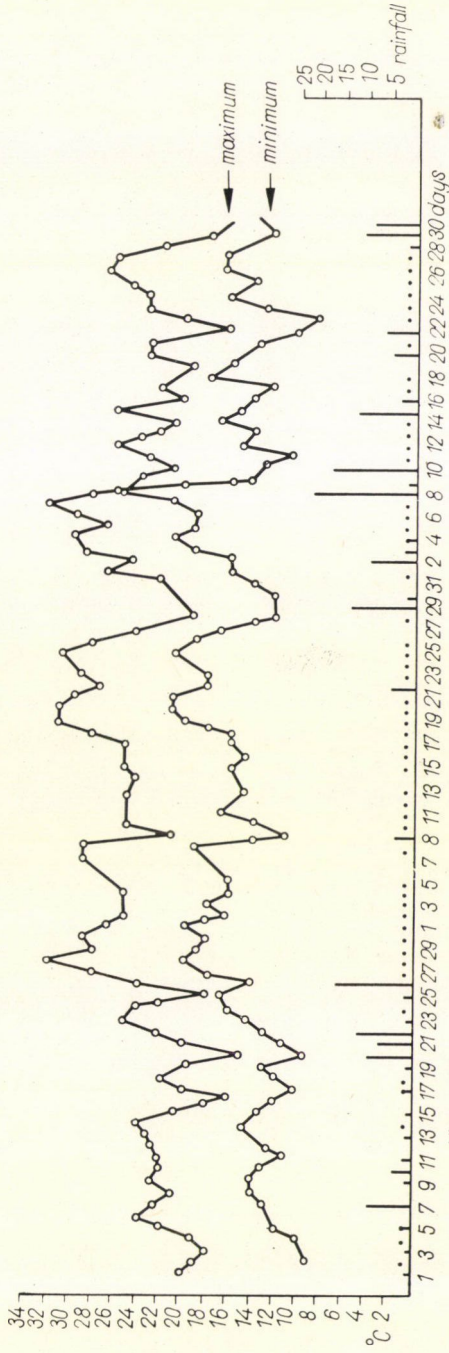

Fig. 1. **Daily temperature maxima, minima and precipitation values during the vegetation period 1963**

Results

When examining the growth of fruit from the first fertilization of any musk-melon variety it has been found that to proceed with very great speed during the first 15 days, and subsequently to slow down (Figs. 2—9). Rapid growth accompanying the juvenile condition of fruit is a well-known phenomenon for physiologists. SINNOT has established (1945) in different sort of *Cucurbitaceae* that growth shows a sigmoid curve exhibiting first a minor

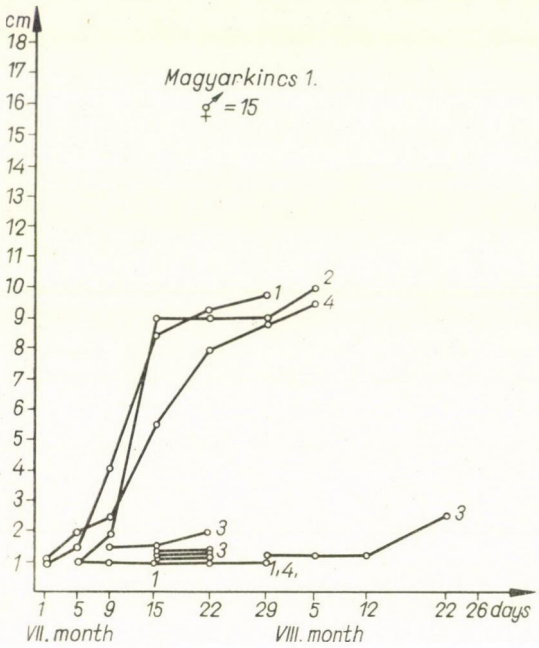

Fig. 2. Shoots of first order of the musk-melon variety *Magyar kincs* and number of decayed and fertilized fruits on them. (In Figs. 2—9 the numbers written at the end of the lines of the Figures indicate the number of the shoots of I. order of the plant, while the numbers marked with a cross on or under the lines the numbers of the fruit decayed or fertilized at that time on the shoot.)

slow rising then a sudden steep line, the exponential phase indicating rapid growth of the volume of the young ovary and finally the curve slowly flattens, growth comes to an end.

The first hermaphroditic flowers 4—6 days after fertilization when having reached a size of 2—3 cm begin to develop rapidly as well as they obtain 65 to 80 per cent of their full size in 10 to 11 days (Figs. 2, 7). A growth of such extent can be observed in the case of optimum weather conditions as experienced in 1963. Warm days before the flowering (Fig. 1) were followed at flowering by very warm days and nights and later on canicular heat with some precipitation promoted development of the melons.

After the first fertilizations practically no further hermaphroditic flowers or only a few appear the lot of which is decay or stagnation. Flowers opened in the first 4—5 days have equal chance for subsistence or later growth, respectively but their future is decided by their position on the shoot or by that related to the fruit already set. Those on lower nodus are invariably in a more advantageous position. After the first setting the other fertilized flowers will drop in a few days as a result of the rapid growth of fruit (Figs. 4, 5, 7) or will

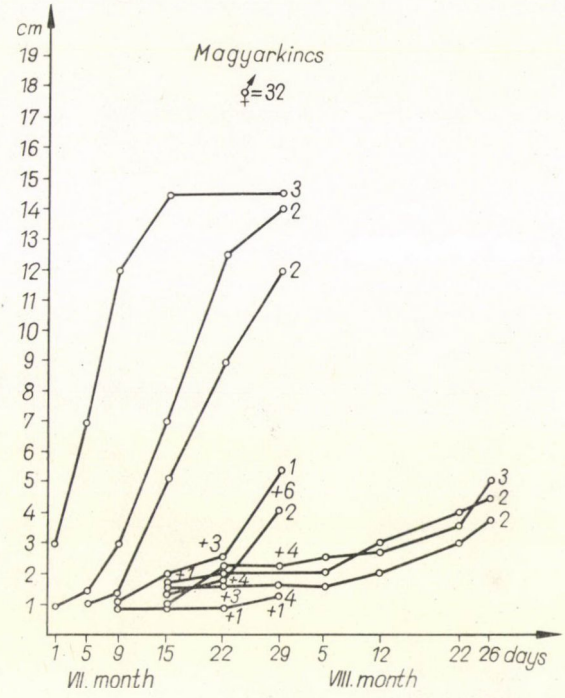

Fig. 3. The number of the shoots of first order of the musk-melon variety *Magyar kincs* 2 and of decayed and fertilized fruit on them

be forced into a state of stagnation (Figs. 2, 5, 6, 7, 8, 9) which may last for 6 days or 30 days; eventually after the removal of developed fruit they may show signs for development. While from the first flower in 34—36 days ripe fruit is obtained, these small fruit forced into stagnation and subsequently resuming development need 60—64 days until the condition of maturation.

At the upper point of inflexion of the sigmoid growth curve growth will slow down but the fruit proceeds toward maturation. At the same time hermaphroditic flowers will appear in a great number (Figs. 2, 3, 4, 6) and in this period flowering of melons will attain maximum intensity one or two weeks. After this second fruit set there follows again the decay of small fruit which is proportional to the intensity of maximum flowering. An overwhelming part

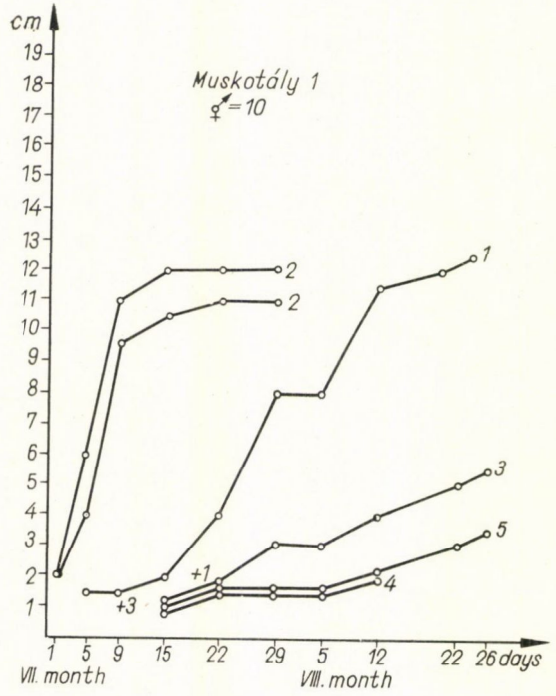

Fig. 4. The numbers of the shoots of first order of the musk-melon variety *Muskotály 1* and of decayed and fertilized fruit on them

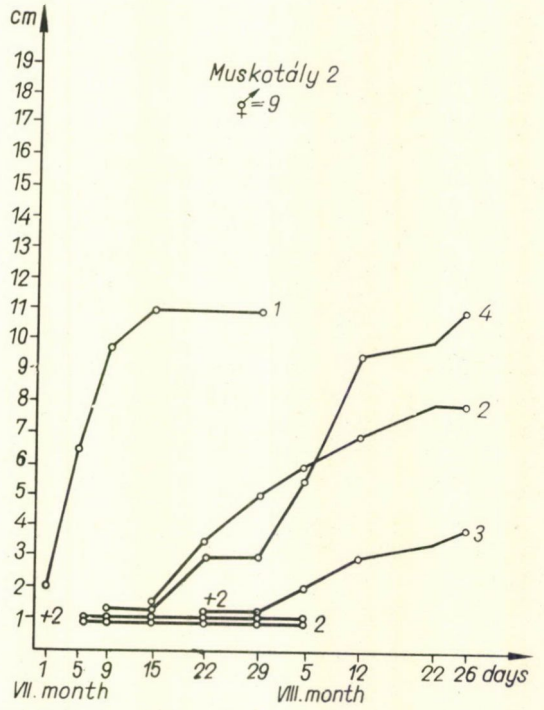

Fig. 5. The number of the shoots of first order of the musk-melon variety *Muskotály 2* and of decayed and fertilized fruit on them

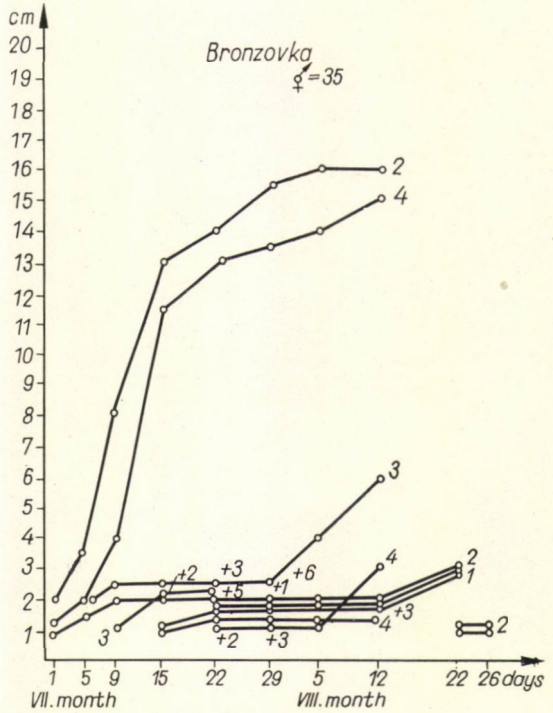

Fig. 6. The number of the shoots of first order of the musk-melon variety *Bronzovka* and of decayed and fertilized fruit on them

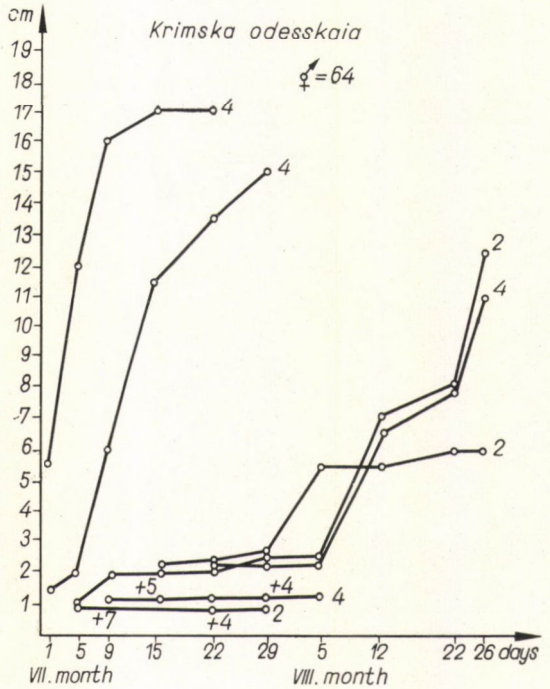

Fig. 7. The number of the shoots of first order of the musk-melon variety *Krimska Odesskaya* and of decayed and fertilized fruit on them

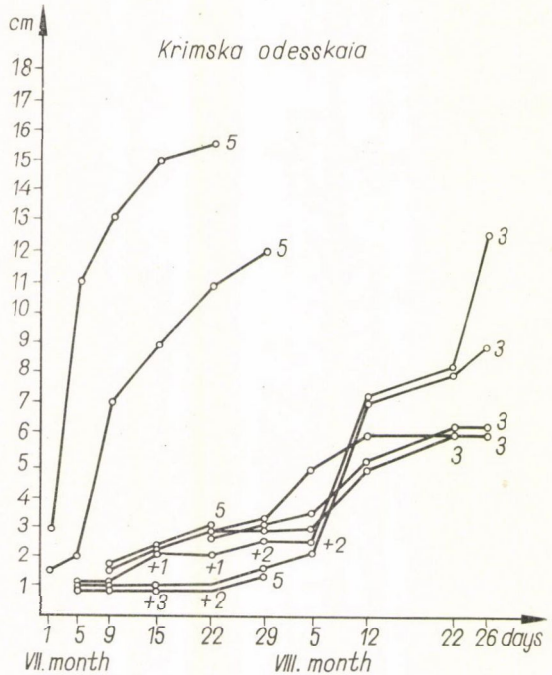

Fig. 8. The number of the shoots of first order of the musk-melon variety *Krimska Odesskaya* and of decayed and fertilized fruit on them

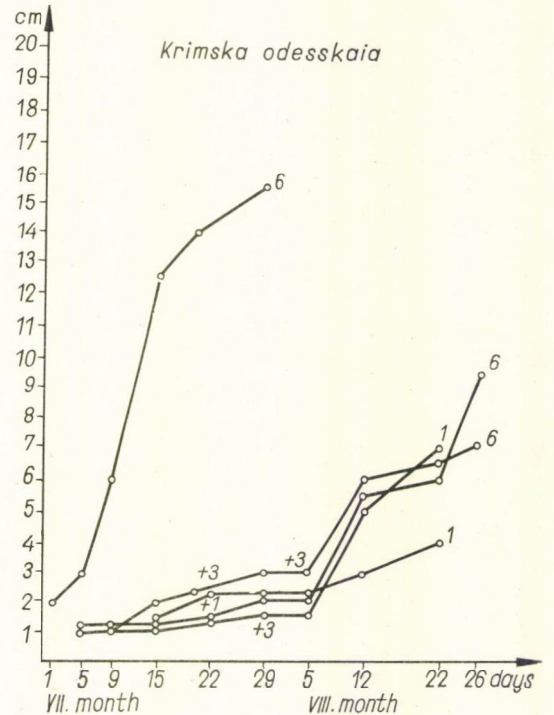

Fig. 9. The number of the shoots of first order of the musk-melon variety *Krimska Odesskaya* and of decayed and fertilized fruit on them

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of the young fruit drops between 15 and 22 July (Figs. 2, 3, 6, 9) together with a part of what have been in the condition of stagnation since the first flowering (Figs. 5, 7, 8, 9). From the flowering during the slow growing and ripening period of 1—3 or perhaps more one will be potentially capable of development. In the variety with less hermaphroditic flowers (Figs. 4, 5) this phenomenon is not conspicuous and does not supply less fruit yield than does abundant flowering.

After the removal of fruit follows the second period of growth showing a similar position as was the first one. Once developed fruit being picked the second yield will develop either from the first tiny stagnating fruits of 1—2 cm size (Figs. 4, 7, 8, 9) or from the flowers fertilized in the area of the upper point of inflexion of the sigmoid curve (Figs. 3, 7, 8, 9) and their rapid growth generally sets on in 6—7 days. This period is certainly the time of development necessary for the utilization of transporting bundles in the new direction, and is the lower inflexion of the sigmoid curve.

Fruits of first growing affect not only further flowering but also the growth of potentially capable simultaneous development, by inhibiting them (Figs. 3, 4, 5, 8). These are growing slower and having attained a size of 4—6 cm turn yellow and drop. The rapid growth of 2—3 or 4 fruit during the first short period makes maximum use of the physiological potential of the plant and a concurrence takes place for the necessary metabolites. By this time the plants will have developed only half of their foliar surface. By 15th July 12—16 nodi can be counted per sprout and by 15th August there are 30—32 developed nodi, this being the date when the full foliar surface has been attained. In the rapid growth period of the second yield no decay of the 4 to 6 cm fruit was observed. It seems that the insufficient assimilation surface and the non satisfactory water supply may -- in the first cycle — cause the decay of fruit in the concurrence.*

Conclusions

Flowering depends on the endogenous condition of plants, on a certain level of the hormones. The role of auxine in flowering as antagonist is well known; at a sufficiently low level it does not inhibit flower differentiation whereas on a higher level it displays an inhibitory effect; if by a certain concentration vegetative growth is just prohibited, hereby flowering is promoted (Leopold 1955, 1958).

With the onset of flowering and then of fertilization a new intrinsic state arises which is composed of the complicated interaction of the former and

* In Bulgaria in glass house growing with musk-melon grafted on vegetable marrow stock the 2 lower sprouts of the stock are spared and a larger assimilation surface developed. Hereby the yield of melons per plant is raised to 9—10 kg.

newer regulating substances. The juvenile fruit signify a new physiological phase in which during the rapid growth period at first mainly the gibberellins (expansive growth) and the kinins (cell divisions) play a role, while in the period of slower growth, among other regulators the auxins will dominate (LUCKWILL 1953, 1959, OVERBEEK 1962, SASTRY—MUIR 1963). According to DENFFER (1950) flowering is inhibited and/or the vegetative trends realized by the hormones accumulated in seeds and embryos.

When using for the fruit growth sigmoid curve the order of the above regulating substances as a background, flowering can be imagined in the two cycles of vegetative growth — flowering and vegetative growth — fruit growth as follows. Under non-inhibiting conditions the first hermaphroditic flowers appear. In the time between flowering and preliminary differentiation of these flowers (15—16 days) there may have been a period (more intensive vegetative growth) in which some sort of inhibition (auxin level) must have occurred. This, however, ceased during the first flowering and made differentiation of flowers appearing in two week's time possible. At the initiation of the latter hermaphroditic flowers the first set fruit slowly increases. During the rapid growth of juvenile fruits (10—12 days) or at least during the first half of this period no such hormones could have been involved that could have annihilated induction of flowering and differentiation. From the seeds of developing fruits e.g. in apple and tomato LUCKWILL (1953, 1959), SASTRY—MUIR (1963) 12—14 days after fertilization, demonstrated from the developing seeds a rather significant amount of auxin 12—14 days after fertilization which, for a certain period, increases and comes to an end with the cellular development of the endospermium. This condition begins, as regards time, at the upper inflexion point of the sigmoid curve, when the second hermaphroditic flowering of great intensity is unfolding. Subsequently in 1 or 2 weeks, respectively decay at a high rate of young fruit and partly their constraint to stagnation take place. The cause must be sought again in fruit being in the process of maturation approaching full size. We may refer also to the above-mentioned embryo (DENFFER 1950) in the endospermium (LUCKWILL 1953) the effect of endogenous auxin reaching maximum amount and then suddenly decreasing as well as to other regulators active in this stage of the fruit. Although several authors (MCGLASSON—PRATT 1963, LEEPER 1951, LU-WANG 1959) have dealt with the fruit ripening process of musk-melon, still little is known about the effect of ripening fruit, on flowering and on the growth of younger fruit.

The cyclic life processes of musk melon as a result of indetermined growth (growth, flowering — fruit growth, flowering — fruit ripening and repeated fruit growth) make the plant well suitable for the detection of many problems concerning flowering and physiology of fruit. The morphological changes, the differentiation of the plant's organs in time and space are attributes of intrinsic life activity based on a complicated system of substances.

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EFFECTS OF SOIL MOISTURE ON THE GROWTH AND NUTRIENT ABSORPTION OF GRAPES

By

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Vine growth and nutrient absorption of *Delaware* grapes were observed in soils of different moisture as "*High*" 83—22% of water holding capacity, "*Medium*" 65—55%, "*Low*" 55—50% and "*Very low*" 48—35%. As a result, apparent assimilation, shoot elongation, weight growth of a plant, blooming rate of flowerlets per cluster and berry development were all inferior with decreasing soil moisture.

When temperatures rose rapidly after the end of the rainy season, several leaves at the base ot the shoots were discolored and shed early. Except for the "*Very low*" plot where the leaves dropped least, the lower the soil moisture, the more severe was the defoliation. Particularly, the damage was greatest in the "*High—Very low*" plot where the soil moisture was changed from "*High*" to "*Very low*" in early July.

Leaf content of Mg was markedly influenced as compared with those of N, P, K and Ca when the soil moisture was reduced. It decreased so much as to reach a level of deficiency with fruiting vines both in the plots of "*High—Very low*" and "*Very low*". Therefore most severe defoliation in the "*High—Very low*" plot might have been induced by the rapid change of water condition as well as Mg deficiency due to drought.

In the measurement of the daily change of berry size, the berries shrunk during the day and enlarged again at night in summer. The difference of berry size between day and night became greater with decreased soil moisture.

Introduction

When the soil moisture decreased below the moisture equivalent, the shoot and fruit growth of grapes planted in pots was greatly retarded. Shoots almost ceased elongating and fruit began to shrink fairly above the permanent wilting percentage. On this experiment, these effects were also observed with vines grown in soils of different moisture levels; observation was made especially from the standpoint of nutrient absorption as affected by reduced soil moisture.

Materials and Methods

Materials: 2 year-old non-fruiting and 3-year-old fruiting Delaware grapes were planted singly in pots, 30 cm in diameter, with sandy loam of granite. On February 25, each pot received 1.0 gm of nitrogen, 0.2 gm of potassium. Again on June 2, 0.5 gm of nitrogen, 0.2 gm of phosphoric acid and 0.2 gm potassium were applied. Soil moisture in each treatment was maintained at a given level as indicated in Table 1, by changing the date and amount of watering according to the condition. That is, "*High*" moisture level was 83—72% of water holding capacity, "*Medium*" 65—55%, "*Low*" 55—50%, and "*Very low*" 48—35%. The soil surface was covered tightly with polyethylene film to check the water loss by evaporation and water

supply by rainfall. Furthermore, board covers were used on the pots to control any increase of soil temperature due to sunlight.

Climatic conditions during the experiment are shown in Table 2.

Table 1

Soil moisture in each treatment

Soil moisture	% of water holding capacity
High	83—72%
Medium	65—55%
Low	55—50%
Very low	48—35%

Remarks; Water holding capacity; 31.43%
Permanent wilting percentage; 3.60%
(based on dry soil weight)

Table 2

Climatic conditions during the experiment

		Air temp.			Evap. mm	Humid %	Total precip. mm	Total solar-radia. hr	No of fine days	Remarks
		Over °C	Max °C	Min °C						
May	Early	19.6	24.2	12.9	3.4	63.8	67.0	45.6	5	
	Middle	20.1	24.5	14.9	3.3	72.4	37.7	29.8	3	
	Late	19.7	25.6	12.8	3.4	63.0	31.9	43.3	2	
June	Early	22.1	26.2	15.6	4.2	62.2	63.2	42.4	3	Concentr. rainfall at the end of month
	Middle	21.2	26.1	16.1	3.5	68.2	68.2	18.8	3	
	Late	23.4	27.3	19.9	1.6	81.7	424.5	15.6	0	
July	Early	26.4	30.6	23.7	3.5	80.0	65.9	26.2	3	Thunderstorms occurred frequent. at beginning of month
	Middle	28.7	32.2	23.1	4.0	72.2	85.7	43.6	1	
	Late	29.0	32.2	23.6	4.7	71.4	80.2	56.2	7	
Aug	Early	27.5	31.5	23.9	3.7	73.2	116.0	31.1	1	
	Middle	29.7	32.8	23.6	4.9	69.8	6.0	57.2	7	
	Late	28.8	33.2	22.9	4.3	68.5	26.1	7.0	10	

Results

1. Vine growth and early defoliation

i) Elongation and weight growth. Seasonal shoot growth of fruiting vines and their growth weight at the end of experiment is indicated in Table 3.

Some differences began to appear among the treatments in early or mid June, and this tendency became greater as the season advanced. The index numbers of total shoot length on August 18 both in the treatments of non-fruiting and fruiting vines were as follows; "*High*" 100, "*Medium*" 80 and 76, "*Low*" 32 and 27, and "*Very low*" 27 and 28. Shoot growth in the plots of "*Low*" and "*Very low*" became less in mid or late May, nearly ceasing, in early or mid July. All fruiting vines in these plots died in late June or early July. A similar trend of differences concerning the leaf size at the base of shoot and weight growth of vines was also found among the treatments (Table 3).

ii) Defoliation. When the air temperature rapidly grew in mid July after the end of the rainy season, several leaves near the base of current shoot were discolored and shed early. The states of defoliation on July 24 with non-fruiting and fruiting vines are shown in Table 4, respectively.

With the exception of the "*Very low*" plot, the lower the soil moisture, the severer was the defoliation. Particularly, both the number of fallen leaves and their per cent were greatest when the treatment was changed from "*High*" to "*Very low*" on July 6. On the contrary, the damage was least in the "*Very low*" plot where the soil moisture was kept *Very low* through the growing season.

Table 3

Vine growth as affected by soil moisture

Soil moisture	Shoot length (Aug. 18)		Leaf area		Total weight of vine	
	Non-fruit	Non-fruit	Fruiting	Fruiting	Non-fruit	Fruiting
High	154.7 cm (100)	416.0 cm (100)	53.1 cm^2 (100)	82.2 cm^2 (100)	91.3 q (100)	345.7 g (100)
Medium	124.0 (80)	317.0 (76)	40.3 (76)	66.2 (81)	86.8 (95)	296.3 (85)
Low	50.0 (32)	112.2* (27)	33.5 (63)	27.8* (34)	35.7 (39)	240.0* (59)
Very low	41.0 (27)	112.8* (28)	32.2 (61)	19.5* (24)	29.5 (32)	128.0* (37)
*High—Very low*** ...	126.3 (82)	346.5 (83)			68.8 (75)	284.0 (84)

Remarks; * All vines died in late June or early July.
** Soil moisture was changed on July 6.

Table 4

State of defoliation on July 24
(with non-fruiting vines)

Soil moisture	Total no. of leaves per vine	No. of shed leaves per vine	Per cent of shed leaves
High	35.7	5.7	15.9
Medium	35.3	7.0	19.8
Low	21.7	7.7	35.4
Very low	20.3	2.7	13.1
High—Very low	35.7	12.7	35.5

2. *Fruit development*

i) Blooming and fruit setting. With 3-year-old vines, blooming time and opening rats of flowerlets of clusters in each plot were investigated. As indicated in Table 5, flowerlets bloomed 2 or 3 days earlier in the "*High*" and "*Medium*" plots than in the "*Low*" and "*Very low*" plots. The opening rate of flowerlets of clusters was 100% in either plots of "*High*" and "*Medium*", while it was 90% and 75% in the "*Low*" and "*Very low*" plots, respectively.

Furthermore, fruit setting observed on June 10 was superior in the "*High*" plot with well developed clusters and berries, followed by the "*Medium*" plot. On the "*Low*" and "*Very low*" plots, it was inferior, having many unfertilized berries.

ii) Fruit growth and quality. The results are presented in Table 6. As the total berry number per vine different among the plots, it was almost impossible to obserwe the direct effects of soil moisture on the growth and quality of fruit. Also, all fruiting vines in the "*Low*" and "*Very low*" plots died in late

Table 5

Blooming time and rate

Soil moisture	Blooming rate (%) May								
	23	24	25	26	27	28	29	30	Total
High	0	5	15	20	30	25	5	0	100
Medium	0	10	10	25	35	15	5	0	100
Low	0	0	0	0	10	40	30	10	90
Very low	0	0	0	5	15	20	25	10	75

Remarks; 10% of flowerlets in "*Low*" and 25% in "*Very low*" never bloomed.

Table 6

Fruit growth and quality as affected by soil moisture

Soil moisture	Diameter of berry			Berry quality (Aug. 18)		
	June 6	July 5	Aug. 18	Color degree	Soluble solid content	Tartaric acid content
High	2.6 mm	11.7 mm	12.6 mm	2.1	19.3%	0.371%
Medium	2.3	10.2	10.7	3.2	19.2	0.321
Low	1.5	6.8	Dead	—	—	—
Very low	1.6	6.5	Dead	—	—	—
*High—Very low**	2.6	11.7	11.3	3.1	16.2	0.262

Remarks: * Soil moisture was changed on July 6.

June. Therefore, comparison of berry growth among all of plots was made only on July 5 with the following value, "*High*", 11.7 mm, "*Medium*" 10.2 mm, "*Low*" 6.8 mm, and "*Very low*" 6.5 mm. Thus, the lower the soil moisture per cent, the smaller was the berry size. To study the effects of soil moisture in summer on fruit, observations were made between the treatment of "*High*" and "*High—Very low*". When the soil moisture was lowered on July 6, diameter growth of berry and its soluble solids content were much lowered, while berry coloring was advanced.

Coloring (ripening): Aug. 10—16.

Daily changed of berry size was measured at the end of July. Berries shrunk in daytime and enlarged at night in summer. The lower the soil moisture per cent, the greater was the difference of fruit size between day and night.

3. Nutrition

i) Leaf assimilation and transpiration. Apparent leaf assimilation and transpiration were measured by the punch method and by the cobalt-paper method, respectively.

The results are shown in Table 7. Both the rates of assimilation and transpiration decreased markedly with decreasing soil moisture.

ii) Nutrient absorption. To observe the effects of soil moisture on nutrient absorption leaf analysis of N, P, K, Ca, and Mg was made on July 5 and 27 with non-fruiting and fruiting vines in each plot. These results are presented in Table 8 and 9. No marked tendency was found among the various plots concerning of N, P, K and Ca. Howewer, Mg content decreased with decreasing soil moisture, particulary its value reached a level of deficiency equally both in the "*Very low*" and "*High—Very low*" plots.

Table 7

Assimilation and transpiration as affected by soil moisture

Soil moisture	Assimilation* (mg/m²/h)			Transpiration** (sec)		
	May 25	June 16	Aver.	May 25	June 16	Aver.
High	4.70	5.06	4.88 (100)	31.2	51.8	41.5
Medium	3.63	2.69	3.16 (65)	45.3	86.2	65.8
Low	2.13	1.38	1.74 (36)	55.0	135.0	95.0
Very low	2.31	0.56	1.44 (30)	64.1	212.8	138.5

Remarks: * Measured from 7.00 a.m. to 7.00 p.m.
** Measured from 10.30 a.m. until noon.

Table 8

Leaf analysis with non-fruiting vines
(% dry weight)

Soil moisture	N	P	K	Ca	Mg
July 5 *High*	2.333%	0.156%	0.850%	1.899%	0.462%
Medium	2.457	0.169	0.857	2.383	0.497
Low	2.632	0.112	1.028	2.307	0.232
Very low	2.666	0.098	0.978	1.879	0.231
High	1.975	0.150	0.600	1.928	0.325
Medium	2.364	0.057	0.646	1.820	0.278
July 27 *Low*	2.722	0.041	0.869	1.740	0.266
Very low	2.707	0.115	0.873	2.205	0.254
High—Very low *.	1.787	0.098	0.507	2.235	0.213

Remarks: Analysed with leaves at the basal part of shoot on July 5, and with leaves at the middle part of shoot on July 27.
* Soil moisture was changed from *High* to *Very low* on July 6.

Discussion

On this experiment, I wanted to ascertain the tendency again with vines grown in pots where the soil moisture was kept at given levels through the growing season for each treatment. As a result, the lower the soil moisture within a range of 83 to 35% of water holding capacity, the less were the assimilation, vine growth, blooming rate of flowerlets, fruit setting and fruit growth. The early defoliation in summer was also promoted with decreasing soil moisture, except for the "*Very low*" plot in which the vine growth was most inferior. It was particular interest to note that in the "*Low*" and "*Very low*" plots where

Table 9

Leaf analysis with fruiting vine
(% dry weight)

Soil moisture		N	P	K	Ca	Mg
July 5	*High*	2.331%	0.117%	0.640%	1.622%	0.478%
	Medium	2.328	0.096	0.744	1.928	0.479
	Low	2.610	0.082	0.726	2.129	0.158
	Very low	2.830	0.095	0.813	1.938	0.118
	High	1.131	0.071	0.819	0.879	0.225
July 27	*Medium*	1.836	0.090	0.404	1.879	0.237
	High—Very low ..	1.459	0.085	0.438	2.541	0.195

Remarks: Same as started in Table 8.
All those in the "*Low*" and "*Very low*" were dead by July 27.

the soil moisture was less than 50% of water holding capacity, 3-year-old fruiting vines were all dead, while 2-year-old non-fruiting vines were all alive. The reason for this might be that the water loss due to transpiration was more severe and more rapid in 3-year-old fruiting vines than in 2-year-old non-fruiting vines. That is, the amount of the top growth in the former was more than twice as large as in the later. Similarly, among all of the treatments, the "*High—Very low*" plot where the soil moisture was changed from "*High*" to "*Very low*" in early July regardless of its larger growth of vine, suffered most severely from the early defoliation in summer.

Generally, fruit quality as determined by color degree, and content of soluble solids and tartaric acid, is much influenced by berry size and yield. In a comparison of "*High*" and "*Medium*" plots, it is also shown that the smaller the berry size, the better was the color and the less was the acid content. Of picking had been delayed a short time in the "*High*" plot, the fruit might have reached the same quality as in the "*Medium*" plot. However, if the vines had been alive in the "*Low*" and "*Very low*" plots, both the fruit growth and quality would have been very inferior.

In this experiment with grapes, absorption of Mg was mostly influenced by a decrease of soil moisture as compared with that of other nutrients as N, P, K and Ca. The lower the soil moisture, the less was the Mg content. This fact suggests to me that early defoliation was induced by Mg deficiency due to drought. However, both the number of fallen leaves and their per cent were least in the "*Very low*" plot, though its leaf content of Mg was nearly the same as in the "*High—Very low*" plot where the damage was greatest. Therefore, severe defoliation in the "*High—Very low*" plot might have been caused not only by Mg deficiency, but also by rapid change in the water condition.

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THE ROLE OF ENVIRONMENT AND SELECTION IN AUTUMNIZATION*

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After a short literary expounding, the author submits the results gained in his autumnization experiments on the continuous checking of the starting and experimental plants by testcrosses combined with progeny tests.

The testcross results have proved the genetic purity of the spring wheat starting material. Thus the variation repeatedly established in the winter-spring characters is to be attributed to environmental effect and not to a selection performed once.

1. The fundamental aim of our autumnization experiments that have been conducted for ten years on the subject is to control:

a) whether winter wheat variations really develop in pure lines of spring wheat under the influence of the environment; b) if so, to establish the environmental conditions under which winter wheat plants develop.

In these experiments the continuous checking of the starting and experimental plants by test crossings combined with progeny tests as well as with other genetical, moreover, developmental stage- and other physiological- as well as biochemical analyses, had unanimously proved (RAJKI 1960, 1962c, 1963, 1965a, 1965b, 1966) the autumnization. It means that influenced repeatedly by environment changed in the same direction: autumn environment instead of spring one, changes in the nature of plants — winter type instead of spring one, proved to be inheritable changes. A new requirement, that of low temperature for vernalization developed in the offspring of originally spring type plants, i.e. their heredity changed.

The results obtained so far in our autumnization investigations have been summarized in a treatise to be published in English as early as next year (RAJKI 1967). In this paper — as a continuation of another paper already published (RAJKI 1965b) — we have also touched upon the frequently raised question: "what of the autumnization might be ascribed to environmental effect and what the role of selection might be."

Due to the short time now available, we have to dispense with a detailed reporting on the starting material of our experiments, on the applied methodology and the results obtained. These are at the disposal of those interested in

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the papers referred to as well as in the treatise in press. In reply to the question raised, we only submit the results of some testcrosses combined with progeny tests in relation to the starting material and the variants of converting spring wheat into winter wheat.

2. Winter type and spring type are inheritable properties of quite a number of *Gramineae* among them of wheat. Specialists taking a stand on the gene concept (SPILLMAN 1909, NILLSON-EHLE 1917, BRYAN—PRESSLEY 1921, TSCHERMAK 1923, COOPER 1923, AAMODT 1923, 1927; GAINES—SINGLETON 1926, QUISENBERRY 1931, POWERS 1934, KAKIZAKI—SUZUKI 1940, etc.) ascribe the inheritance of these properties to 1, 2, 3 or more genes, and some (among those enumerated, SPILLMAN and TSCHERMAK) consider the winter type, while others (of the above mentioned the rest) the spring type to be the dominant or ancestral form. The statement of COOPER (1923) is to be mentioned particularly, according to which in F_2 of the winter $\times$ spring crossings the ratio of segregation might be different depending on the winter variety used. Accordingly, it can be supposed that the property is determined by one or two genes.

VAVILOV—KUZNETSOVA (1921) found the spring character to be dominant, however, they were not able to determine the number of the genes. VAVILOV (1935) states that in F_1 the winter $\times$ spring wheat hybrids take up a medium position between the parents concerning the date of flowering and maturing, respectively, being nearer to the spring-type parent where against F_1 hybrid is by some days later in flowering and maturing. According to VAVILOV the spring type and winter type might equally be dominant forms and he sees the fundamental difference between them — in agreement with thousand years' practice — in the fact that the spring races being sown in spring will head, flower and mature crop while the winter types do not. These will only form tillers, however, in that year do not continue developing.

LYSENKO (1937) according to whose investigations in the winter $\times$ spring wheat crossings it is also the spring type that dominates, considers the cause of fundamental differences found in the behaviour of the winter and the spring wheats in their different requirements for vernalization.

POEHLMAN (1959) — similarly to the standpoint of VAVILOV and LYSENKO — considers as a further difference between winter wheats and spring wheats the variances appearing in the type of seedling growth, the capacity for hardening and winter hardiness.

SKRIPCHINSKY (1955) is therefore right in stating that according to our present knowledge just as it used to be in the past, we consider winter wheat the one that, in spring sowing, does not head for the same year while spring type is called the wheat that is heading under similar conditions.

3. We have made autumnization experiments with numerous spring varieties to convert them into winter wheat. In the most versatile manner and the most thoroughly the Soviet spring wheat variety *Lutescens 62* (hereafter

L 62) has been examined in our experiments. This variety had been produced, by individual selection, from the local variety *Poltavka* and was registered in 1929. The initial plant for *L 62*, was selected by SHEHURDIN at the Saratov Plant Breeding Station in 1911. That variety is most suitable for autumnization investigations because it is not of hybrid origin but an old spring wheat variety not being winter hardy at all (YAKUBTSINER—SAVITSKY 1947, RAJKI 1962a). The seed used in the experiments came from the Genetics and Plant Breeding Department of the Moscow Timiryazev Agricultural Academy where I myself selected the starting plant material from the 1954 crop as ears being characteristic for the variety. These ears served as the starting material of cycle I beginning in 1955 and cycle II starting in 1957. For cycle III beginning in 1962, the starting material was renewed through procuring material, the plants *L 62*, again from the Genetics and Plant Breeding Department of the Moscow Timiryazev Agricultural Academy (hereafter, where the discrimination is reasonable, $L\ 62_M$). Upon our request the ears of these plants had been individually isolated by B. FAYNBRON and after maturing were sent to us in the form of plants with isolated ears. For this favour I wish to express my thanks herein.

In order to exert fuller control with the spring wheat variety *L 62*, we procured from the All-union Plant Growing Institute, Leningrad — similarly to those from Moscow — plants the ears of which had been isolated upon our request (hereafter $L\ 62_L$). For sending the latter sample I express my thanks to T. SHEVCHUK on this occasion, too.

In cycles I and II of our autumnization experiments we had not yet isolated those plants and ears, respectively, the crop of which was used for further sowing, thus the possibility of biological contamination was not excluded. The latter was realized only in cycle III. In spite of this — as has been mentioned by SKRIPCHINSKY (1957) in connection with a similar methodology expounded by TRUKHINOVA (1957) —, the properly completed operations in the methodology applied in the course of cycles I and II, rendered it possible to establish the occurrence of mechanical and biological contamination, moreover, the nature and heredity of the plants, respectively. As already mentioned, in cycle III grains coming from ears that had flowered under isolator, were used both for winter and spring sowing.

4. For controlling the heredity of spring and winter type in the starting and experimental plant material, we have availed ourselves, as previously mentioned, primarily of the testcrosses combined with spring progeny tests. On the plants originating from the ear- and plant material of the starting *L 62* spring wheat obtained in 1955 and 1962, we have emasculated ears in the manner generally applied in breeding work. On the stigma in emasculated flowers of the plants (mother plants) the matured anthers of a winter wheat variety or of the starting *L 62* have been placed. The emasculated and then pollinated ears

were isolated with cellophane. The grains obtained by pollination thus performed, as well as those forming on the mother plant being free pollinated i.e. without emasculating, however, under isolator, were sown in spring — generally in the first week of April, — in separate rows by mother plant or emasculated and pollinated ear and by combination. We have carried out reciprocal, viz. winter × spring *(L 62)* testcrosses, too. In the experiment the grains from the mother-plant as well as those originating from the pollination of the starting *L 62* and a winter variety, have been studied in F_1 and F_2, and with certain combinations also in F_3, determining in spring sowing the heading date of the plants and the percentage of non-heading plants. From these two data we concluded the spring or winter character of the material examined.

The progenies of the emasculated and pollinated ears of the mother plants in F_1 and F_2 and, where such existed, in F_3 have been sown in separate rows and plots, respectively. In this way in F_2 and F_3 where more ear-progenies and within this, a large number of plants had been raised, we determined in the ear-progenies the mean percentage of non-heading plants and the sample standard error.

In *Table 1* the results of the test crosses made with *L 62* sown consistently in spring, can be seen. In F_1 crossing performed with the winter wheat variety

Table 1

Testcrosses
1959—1965

Serial number	Combination	Number of plants	± number of days, as related to the mean heading date of L 62	% of plants non-headed
				$\bar{x} \pm s_{\bar{x}}$
1.	L 62 × L 329 F_1	111	+5	0
2.	L 329 × L 62 F_1	129	+5	0
3.	L 62 × L 329 F_2	1741	+7	10.5 ± 0.83
4.	L 329 × L 62 F_2	2334	+8	12.7 ± 0.91
5.	L 62 × L 329 F_3	1717	+8	9.7 ± 1.46
6.	L 329 × L 62 F_3	1492	+7	11.0 ± 1.87
7.	$L\ 62_M$ × L 62 F_1	293	0	0
8.	$L\ 62_M$ × Bez. 1 F_1	56	0	0
9.	$L\ 62_M$ × L 62 F_2	1701	0	0
10.	$L\ 62_M$ × Bez. 1 F_2	1138	.	19.1 ± 1.35
11.	$L\ 62_L$ × L 62 F_1	33	0	0
12.	$L\ 62_L$ × Bez. 1 F_1	9	0	0
13.	$L\ 62_L$ × L 62 F_2	248	0	0
14.	$L\ 62_L$ × Bez. 1 F_2	235	.	18.7

. = there was no individual observation of heading.

L 329 requiring vernalization longer than 50 days (RAJKI 1960), the spring character was dominant. The F_1 plants headed by 5 days later both in direct and reciprocal crossings than did *L 62*. In F_2 10—12% of the plants did not form ears (recessive winter types). In F_2 there were a little more plants not heading than in F_3, and in the reciprocal crossing than in the direct one. It is worth mentioning that in F_2 and F_3, in direct 24.8 and 12.8% of the plants formed ears simultaneously with *L 62* while in reciprocal crossing these figures were 5.6 and 13.6%.

The vernalization requirement of an other winter wheat variety: the *Bez. 1* used in test crossings and shown in *Table 1*, is 45 days (RAJKI 1967). In the F_1 of the crossing *L 62* × *Bez. 1*, — similarly to the previous combination, — it was the spring character that dominated. It is interesting to note that in this combination F_1 formed ears at the same time as *L 62*, and the percentage of plants not heading in F_2 considerably exceeded the values established in the previous combination.

In F_1 and F_2 *L 62* headed together both with $L\ 62_M \times L\ 62$ and $L\ 62_L \times L\ 62$. The values obtained in the F_1 and F_2 of the crossing $L\ 62_M \times$ *Bez. 1* also agree with those of $L\ 62_L \times$ *Bez. 1*.

Thus, the results of the testcrosses prove unanimously the genetical purity of the starting spring wheat material *L 62* (including also $L\ 62_M$ and $L\ 62_L$). It is proved that the starting material was genetically spring wheat viz., being sown continuously in spring, it is exclusively of spring heredity. In the course of analysing the changes established in certain properties of plants obtained as a result of autumnization we have reverted repeatedly on the genetical purity of the starting spring wheat (RAJKI 1967).

5. We have already reported on the main results of the autumnization cycle I in several publications (RAJKI 1960, 1962a, 1962b, etc.) Now we want to make acquainted some so far unpublished test results in order to submit further proofs of conversion.

Of the *L 62* lines in cycle I now we examine certain variants of 132/58—59. According to reports on the question (RAJKI 1960, 1962a) in this line the conversion into winter wheat had started after two adequate winter sowings, and after three winter sowings we were able to separate the first sublines that had become of completely winter character.

a) Let us see, first of all, *Fig. 1*! The WWWWW variant 629/59—60 can be considered as being converted into winter type on the basis of the heading dynamics (progeny test in spring sowing) in the subline 1153/60—61 isolated from it. Similarly we might consider the WWWSW variant 630/59—60 as being winter type according to the heading dynamics of the subline 1155/60—61 isolated from it. Because of its high-degree winter hardiness (RAJKI 1962a) the WWSSW variant 634/59—60 can be considered as a winterhardy spring or alternate wheat. This — according to the heading dynamics of the subline

1159/60—61 being isolated from it, — when sown in spring, headed completely, however, by 8—10 days later than the starting spring wheat *L 62* (SSSSS).

b) The testcrosses shown in *Table 2* confirm the conclusions drawn from the progeny test. Let us first see the testcross results of WWWWW variant 629/59—60 that has become of entirely winter character. In the F_1 of *L 62*—629×*L 329* not a single plant has headed proving that *L 62*—629, like *L 329*, is a winter wheat. In the F_1 of *L 62*—629×*L 62* the spring character dominates. In F_2 and F_3 — similarly to the basic testcross, — part of the plants (11.9 and 8.2%, respectively) remained "sitting", they have not headed. It proves that

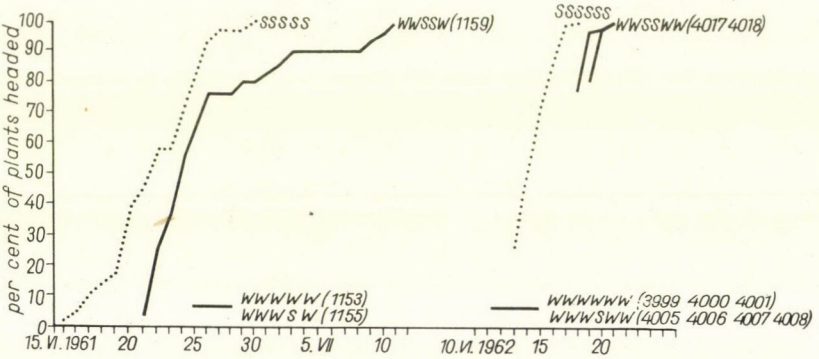

Fig. 1. Heading dynamics Cycle I. 1961—1962

the subline *L 62*—629/59—60 has become genetically winter wheat under the effect of adequate winter sowings and the winter conditions determined by them.

c) From *Fig. 1* it can be seen that the WWWWWW variant 1153/60—61 according to the heading dynamics of the sublines 3999, 4000 and 4001/61—62 isolated from it — in agreement with the spring progeny test of the previous year — might be considered as being converted into winter wheat. Similarly we can consider the WWWSWW variant 1155/60—61 of winter character according to the heading dynamics of the sublines 4005, 4006, 4007 and 4008/61—62 being isolated from it. The behaviour of WWSSWW variant 1159/60—61 is invariably alternate; according to the heading dynamics of the sublines 4017 and 4018/61—62 it gets entirely headed in spring sowing, however, in 1962 this occurred by 5 days later only than did the starting *L 62* (SSSSSS) spring wheat.

d) The testcrosses shown in *Table 3* again confirm the results of the two year progeny tests and the testcrosses of the previous year, as already mentioned. The variants WWWWWW and WWWSWW having become entirely of winter character behave in F_1 and F_2 as the real winter type. When crossing

Table 2

Testcrosses

(L 62—132/58—59 — 629/59—60 — WWWWW)
Cycle I. 1959—1963

Serial number	Combination	Number of plants	± number of days, as related to the mean heading date of L 62	% of plants non-headed
				$\bar{x} \pm s_{\bar{x}}$
1.	L 62 × L 329 F_1	111	+5	0
2.	L 329 × L 62 F_1	129	+5	0
3.	L 62—629 × L 62 F_1	89	+5	0
4.	L 62—629 × L 329 F_1	120	—	100
5.	L 329 × L 62 F_2	2334	+8	12.7 ± 0.91
6.	L 62—629 × L 62 F_2	1240	+5	11.9 ± 0.86
7.	L 329 × L 62 F_3	1492	+7	11.0 ± 1.87
8.	L 62—629 × L 62 F_3	4701	+6	8.2 ± 0.91

Table 3

Testcrosses

(Several variants□ of L 62—132/58—59)
Cycle I. 1960—1963

Serial number	Combination	Number of plants	± number of days, as related to the mean heading date of L 62	% of plants non-headed
				$\bar{x} \pm s_{\bar{x}}$
1.	L 62 × Bez. 1 F_1	56	0	0
2.	L 329 × L 62 F_1	129	+5	0
3.	WWWWWW × L 62 F_1	46	+6	0
4.	WWWWWW × Bez. 1 F_1	20	—	100
5.	WWWSWW × L 62 F_1	69	+4	0
6.	WWWSWW × Bez. 1 F_1	21	—	100
7.	WWSSWW × L 62 F_1	65	+3	0
8.	WWSSWW × Bez. 1 F_1	29	+3	0
9.	L 62 × Bez. 1 F_2	1138	.	19.1 ± 1.35
10.	L 329 × L 62 F_2	2334	+8	12.7 ± 0.91
11.	WWWWWW × L 62 F_2	177	+5	3.9
12.	WWWSWW × L 62 F_2	182	+4	4.9
13.	WWSSWW × L 62 F_2	1276	+2	0
14.	WWSSWW × Bez. 1 F_2	634	+3	21.0 ± 4.3

□ WWWWWW = L 62—629—1153/60—61
WWWSWW = L 62—630—1155/60—61
WWSSWW = L 62—634—1159/60—61

the alternate WWSSWW variant with *L 62*, it headed both in F_1 and F_2. The F_1 plants of the same variant and *Bez. 1* got also headed, while in F_2 — in a similar ratio to the F_2 of the *L 62* × *Bez. 1* basic testcross, — recessive winter wheats segregated.

6. From cycle II we submit here the results of some testcrosses, combined with progeny test, of variants of converting spring wheat into winter wheat *(Fig. 2)*.

In *Table 4* we show the testcross data, in F_1 and F_2, of two WWWWW sublines, *L 62*—3808 and 3839 having become — according to the heading dynamics *(Fig. 2)* — entirely of winter character, as well as of two WWWWW

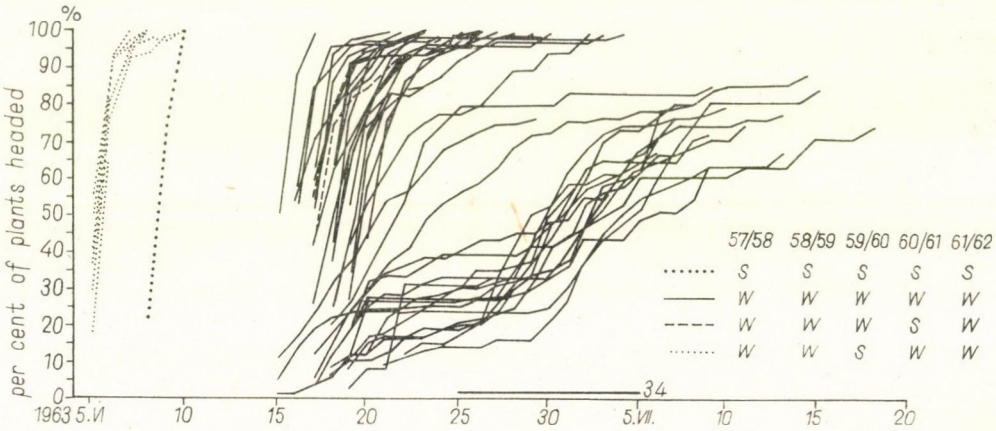

Fig. 2. Heading dynamics Cycle II. 1963

sublines, *L 62*—3809 and 3840 that — though considerably late — have headed completely, and of the starting material, the SSSSS (in *Table 4: L 62)* being sown continuously in spring.

According to the evidence of testcrosses, the sublines 3808 and 3839 became genetically of winter character: when crossing with winter wheat not a single plant headed in F_1; when crossing with the starting spring *L 62*, in F_2 there segregated winter plants. Neither are the sublines 3809 and 3840 identical with the starting *L 62:* in crossings with winter wheat, the heading in F_1 was considerably late (by 30 and 34 days, respectively), they have produced no crop; crossed with the starting *L 62*, the heading was late in F_2. The latter sublines might be considered as late spring wheats converting from spring wheat into winter wheat.

Similar results were obtained in further testcrosses of some variants in cycle II of which in 1965 only the F_1 generation could be raised. Here we have used as winter variety *Mir. 808* the vernalization requirement of which is more than 50 days (RAJKI 1967). Crossing with winter wheat, the F_1 plants

Table 4

Testcrosses

(Four sublines of L 62—1086/59—60 — WWWWWW)
Cycle II. 1963—1965

Serial number	Combination	Number of plants	± number of days, as related to the mean heading date of L 62	% of plants non-headed
1.	L 62 × Bez. 1 F_1	56	0	0
2.	L 329 × L 62 F_1	129	+ 5	0
3.	L 62—3808 × L 62 F_1	62	+ 3	0
4.	L 62—3808 × Bez. 1 F_1	62	—	100
5.	L 62—3809 × L 62 F_1	23	+ 3	0
6.	L 62—3809 × Bez. 1 F_1	8	+30	0□
7.	L 62—3839 × L 62 F_1	38	+ 2	0
8.	L 62—3839 × Bez. 1 F_1	5	—	100
9.	L 62—3840 × L 62 F_1	45	+ 2	0
10.	L 62—3840 × Bez. 1 F_1	12	+34	0□
11.	L 62 × Bez. 1 F_2	1138	.	19.1
12.	L 329 × L 62 F_2	2334	+ 8	12.7
13.	L 62—3808 × L 62 F_2	435	.	5.1
14.	L 62—3809 × L 62 F_2	271	.	0□□
15.	L 62—3839 × L 62 F_2	323	.	9.6
16.	L 62—3840 × L 62 F_2	358	.	0□□

□ not becoming ripe
□□ heading long last

in the case of the starting spring *L 62* as well as of the spring WWSWWWW and of the alternate WWWSWWW — both the latter being regarded as such according to the respective heading dynamics — have all headed. Similar was the behaviour of WWWWWWW being taken for a late spring wheat, — also on the basis of the results of the testcrosses shown in *Table 4* —, however, the heading of the F_1 plants of the latter was postponed. There was no heading at all in the F_1 plants of WWWWWWW being determined as winter wheat — also according to the heading dynamics —, and of the winter wheat *Mir. 808* proving that in the course of autumnization this variant converted genetically from spring wheat into winter wheat.

7. The autumnization cycle III has started in 1962. In *Table 1* we have already seen testcross data (lines 7—10) referring to the starting material. From further testcrosses carried out in the course of autumnization only the F_1 generation could be raised in 1965. As winter variety for the testcrosses

Mir. 808 was used. In F_1 of the crossing *L 62* × *Mir. 808* it is also the spring character that dominates. In the testcrosses there took part the variant SW_3W_1 being converted into winter type according to the heading dynamics shown in Fig. 3. When crossing this with *Mir. 808*, the majority of the F_1 plants (55.7%) did not head. Thus, the variant SW_3W_1 is essentially of winter heredity. The partly heading of SW_3W_1 × *Mir. 808* F_1 plants might have been due to the unusually cool spring of 1965. In possession of data referring to F_2, we shall be able to control the above supposition in 1966.

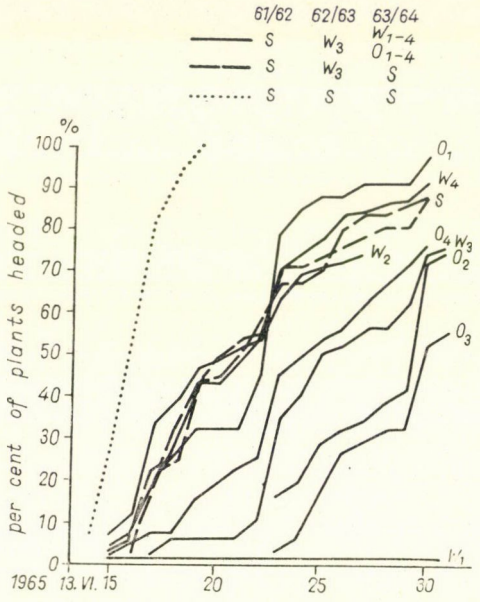

Fig. 3. Heading dynamics Cycle III. 1965

Thus, on the basis of the progeny test- and testcross results shown in cycle III, the plants of the variant SW_3W_1 might be considered as converted genetically from spring type into winter type under the influence of adequate autumn sowings.

8. In the autumnization experiments that have been performed in these ten years, in all three cycles of them: the continuous control of the starting and of the experimental plants by testcrosses combined with progeny test — in agreement with genetical, physiological and biochemical analyses not written about herein — the following have been proved:

a) The starting material of the experiments, the lines and sublines of the wheat variety *L 62* are genetically spring wheats and do not contain visible or latent semi-winter or winter forms.

b) In the genetically pure spring-type starting material the gradual genetical conversion being adequate the quality and quantity of autumn grow-

ing, the variation repeatedly established in the winter — spring characters are the results of environmental effect and not of a selection performed once.

This statement is in agreement with the views of DARWIN (1892) contradicting those who imagine "that natural selection induces variability". At the same time he stresses that selection "implies only the preservation of such variations as arise and are beneficial to the being under its conditions of life".

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VARIA

DEBRECENI KIFEJTŐ BORSÓ

(Round Pea Debreceni)

Fig. 1

Taxonomical place: Pisum sativum L. convar. *vulgare* Alef. var *cimitari* Alef. (LEHMANN, 1954).
Origin: Petit Provençal × Konserven-Königin.
Beginning of breeding: 1948, *Újmajor.*
Breeders: ANTAL ÁCS and LAJOS SZABÓ, College of Agricultural Sciences, Debrecen.
State qualification: improved variety with preliminary certification, 1961 (KAPÁS *et al.* 1965).
General characterization: early variety (ripening 2—3 days after *Express*, the earliest variety of all), tolerant to cold (can be sown also in the autumn in protected situation), a round pea of outstanding productivity, suitable both for the canning industry and marketing (CSATÁRI-SZÜTS—KOMJÁTI, 1963).

Morphological description:

Root system: vigorous, penetrating into medium depth. The main root is ocker yellow and spindle shaped.

Shoot system: low (35—45 cm high), of dense structure, moderately branching. Stem light yellowish green, moderately ribbed, stiffly erect.

Foliage: Dense leaves, yellowish green (medium green) mainly composed of one pair (the higher ones of two pairs) of leaflets ending in a strongly branching tendril. The leaflets are medium large, ovate, their apex pointed, the edge moderately indented, the leaf base cuneiform. The petiole is much longer than the total

length of leaf rachis and tendril. The bracts medium large, semi-ovate, the apex broadly rounded off, the edge moderately indented.

Flowers: generally in pairs in the raceme, on a longer rachis. The ala is claw-shaped, circular. The petals are all white.

Pod: medium large, in marketing ripeness medium green, straight, pointed, containing 7—8 seeds. The mean weight of the pod ranges depending on the year from 3.8 to 5.2 g. From one kg of pods 390—470 g seed can be gained (KOMJÁTI 1962, 1965).

Seed: when young (ripe for the market) light yellowish green, in full ripeness medium green. The ripe seed is medium large, global-ovate with a smaller depression, the diameter ranging from 6 to 11 mm. Thousand seed weight when young 360—470 g, in ripe condition 180—240 g.

Biological characters:

Vegetation period: 53—61 days; length of the most important phenophases: from emergence to flowering 33—42 days, from flowering to harvesting 19 days (KOMJÁTI, 1962, 1965).

Development: rapid and vigorous. Pods develop and ripen uniformly and within a short time (KOMJÁTI 1962).

Resistance to diseases: very good.

Farm technology requirements: No demanding variety, hence its growing is rather safe. Adapted to early seeding. Suitable for machine threshing as the pods ripen simultaneously. Its imperfection to get soon over-ripe when its quality deteriorates, therefore its harvesting must not be delayed (KOMJÁTI 1962). At maturation the seeds rapidly harden, then it must be picked for canning purposes when still young, within a short time.

Productivity: excellent. One of the most productive among early varieties. Pod yield 62.2—71.8 q/ha, seed yield is nearly the half of this quantity.

Region of production: can be successfully grown on good soils in every region of Hungary.

GY. MÁNDY

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VII. BIOLOGICAL CONGRESS, PÉCS 1966

The Biological Congresses arranged since 1956 have offered a good opportunity for expounding and discussing the results of biological research works in Hungary as well as to indicate the new trends of research. One of the main proofs of competence and actuality of the congresses was that the number of papers submitted had exceded the possibilites afforded by the congress and thus a number of papers accepted could not be read for want of time. The misgivings that cast a reflexion on the reason for holding these congresses became soon forgotten and claims were increasingly put forward to compare the scope and level of Hungarian biological research to those of European and international biological research work. The outstanding results of Hungarian biological research were well known even before the congress and this is particularly applied to the field of plant and animal systematical, morphological, anthropological, ecological, and coenological research. In the Fifties started with great impetus also the biochemical, phytophysiological, histochemical and biophysical investigations. A lag behind the international level, however, continued to subsist in the field of submicroscopic cytology, animal physiology and molecular biology. The Hungarian Academy of Sciences reorganized in close co-operation with the Universities the Biological Group as an independent class and thereby called into being the material and organizatory basis of the up-to-date biological research. The VIIth Biological Congress arranged from 19 to 21 May 1966 in Pécs the progress having been enacted reflected well in the field of these disciplines. This progress is very significant since it has not been put forward at the expense of the biological disciplines already existing but along with their parallel evolution. This means in short that the VIIth Biological Congress could be arranged in terms of cell biology and molecular biology. This has also been manifested by the fact that about the half of the lecturers chose their subject from the scopes referred to.

The reports of the joint session gave a high level review of cells and tissues on submicroscopic scale and further on the relationships between the fine structure and functional properties of the ribosomes. The lively debate that followed could convincingly witness that a team expert in molecular biological examination are being developed in Hungary. At the same time it was to regret that owing to the absence of genetical reports we were unable to gain new informations on the actual problems of genetics that have so rapidly been developing in these last years. That the approach to a basic cell biological problem can be satisfactorily realized only by the simultaneous application of several methods it was fully illustrated by the report on the ultrastructure of the pancreas ergastoplasm offering a synthesis of data that could be obtained by the electron microscopic, polarization microscopic and photometric methods. From these observations it was to learn that "the orientated (anisotropic) binding of toluidene blue on the ergastoplasm is a complex structural function: the stain is bound by RNA while the structural lipids orientate the stain molecules". From these facts the authors draw the following assumptions: 1. RNA in conformity with the newer electron microscopic data is *membrane orientated* according to which the ribosomal substance forms a continuous layer and no separate ribosomes on the ergastoplasm. 2. RNA and membrane lipoids are in a close microstructural relation since their common role in orientated stain binding can only be imagined this way.

Cell biological methods and observations afford in many cases valuable help to classic physiological research. Good examples are supplied for this by reports and lectures having attained the solution of certain endocrinological problems by investigations conducted on ultrastructural level. So e.g. in the course of "cytological changes occurring on the action of trophormones" the authors established that the adrenal cortex mitochondria of the crista type were under the influence of ACTH transformed into tubulovesicular structures which from the viewpoint of steroid production results in an increase of surface of about 300 per cent. Electron microscopic cytological examinations brought also new data on the transformation of exocrine pancreas cells into insular cells, the apocrine type hormone discharge of adrenal medulla

of endocrine secretion, on the developmental mechanism of the secretion granules of the exocrine pancreas and of the parathyroid both in adult and embryonal individuals. A number of lectures have disclosed the fine structure properties of organs with ultrastructure perfectly unexplored so far (paraganglion cells, cerebellar moss fibre cells, tentacular cells in snails, etc.) in normal and different developmental and functional conditions.

Among the molecular biological studies in Hungary an observation may be qualified as very significant according to which in the myofilaments of the stripedstriated muscles a new variety of protein, called fibrillin occurs. In connection with the significance of the disulfide bridges in the proteins, new data have been supplied showing that these are not only involved in the structural stiffening of proteins but are indispensable also from the viewpoint of biological activity. Authors have isolated from the pancreas a new enzyme and established that this enzyme catalyses the exchange of the disulfide bridges and this way calls forth the development of inactive, oxydized proteins into active enzyme. A great progress is marked by the examinations dealing with the structural and functional properties of nucleic acids both in the case of cells of normal and carcinomatous tissues. These examinations clarified the RNA and the protein component to be connected with bonds of different strength in case of normal and carcinomatous tissue. A new possibility of the study of cell biological problems was pointed out in the report demonstrating the cell biological significance and role of ultrastructural changes brought about in various tumour cells by chemotherapical agents. The present writer was unable to divide his attention so as to satisfy both his interest and his thematic commitment. Therefore he could not afford time for a number of botanical lectures. The few lectures, however, which he could attend testified that the cell biological research in botany, if numerically not reaching the scope of zoological ones qualitatively they were equivalent. A report on secretion and storage of nutrients supplied new statements concerning glandulotropic volatile oil secretion and established that in this process the plasmolemma, the Golgi vesicle from the dyctiosomes and the endoplasmic reticulum were equally involved. It was quite an experience for the audience to see the small film presenting the secretion of the glandular hairs in vivo.

Although the thematical richdom of the congress is evident already by what has been said so far, still it is worth mentioning that besides the main theme a number of papers were read concerning biochemistry, histochemistry, physiology, oncology, immunology, anthropology, etc. It was also gratifying to find that in the elaboration of the various themes beside the traditional methods the most modern methods and proceeding: kibernetics, isotope technique, light microscopic autoradiography, light and electron microscopic histochemistry were employed. It is to be regretted that inspite of this great thematical richdom no lecture on plant physiology and biophysics was included.

This brief survey cannot aim at completeness and cannot be free of the subjective view and interest of its writer who shares the opinion of Prof. STRAUB exposed in his closing speech that the development of biology needs biologists and the great problems of biology cannot be solved with chemists and physicists alone. The biologists, on the other hand, must dispose of a comprehensive view reaching e.g. from the understanding of the role of the disulfide bridges to anthropology. In the development of this view the Biological Congresses have a basic role.

I. BENEDECZKY

THE EFFECT OF COLCHICINE ON CELL POLARITY AND CELL DIFFERENTIATION IN THE PROTODERM OF ALLIUM CEPA L.

Colchicine (in addition to its generally-known mitosis-inhibiting effect) brings about different structural and functional abnormalities in the cell. Trying to discover a uniform explanation to these it has been suggested that colchicine primarily effects cell polarity and polarity interference is actually behind the mentioned abnormalities (WALKER 1938, WEISSENBÖCK 1949, BÜNNING 1958, WETTSTEIN 1965). Since polarity is of basic significance in cell and

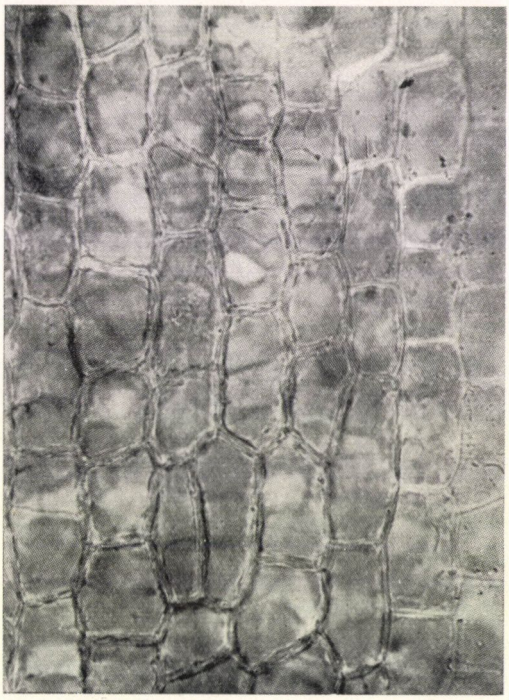

Fig. 1. Close-up of the living protoderm from the untreated cotyledon of the seedling. Magnification c. 400 ×

tissue differentiation, it is understandable that colchicine treatment might be suitable for experimentally intervening in the processes of differentiation.

In the present paper we have studied the differentiation interferences caused by colchicine or rather a few cytological changes occurring under the effect of colchicine in the protoderm of the cotyledon of *Allium cepa*. In our experiments the dry seed and the seedlings of different ages were placed on a filter paper soaked in 0.2% colchicine solution and placed in a Petri dish where they were allowed to grow for 4—10 days.

The longitudinal growth of colchicine treated seedlings lagged far behind that of the control, while the apex of their roots and cotyledons were strikingly thickened.

In the protoderm of the cotyledon of the plants treated from two days of age or even sooner we found no stomata; only stoma mother cells. WEBER (1943) and WEISSENBÖCK (1949) had already described the lack of guard-cell formation in other types of seedlings treated from the dryseed stage. From the comparative study of seedlings treated from different ages we

concluded that in case of normal development the guard-cell formation of bulb seedlings begins only from two days of age.

In our experiments colchicine peculiarly influenced cell and nucleus size, too. While the cells of the control protoderm increase gradually from the base of the cotyledon towards the apex (they primarily become longer), the maximum cell size was found close to the base of the seedlings. In this place the surface of the external tangential wall of the treated cells is twelve times as great as that of untreated cells. Furthermore, it is characteristic that while in the control the frequently dividing meristematic cells bringing about the growth of the protoderm are

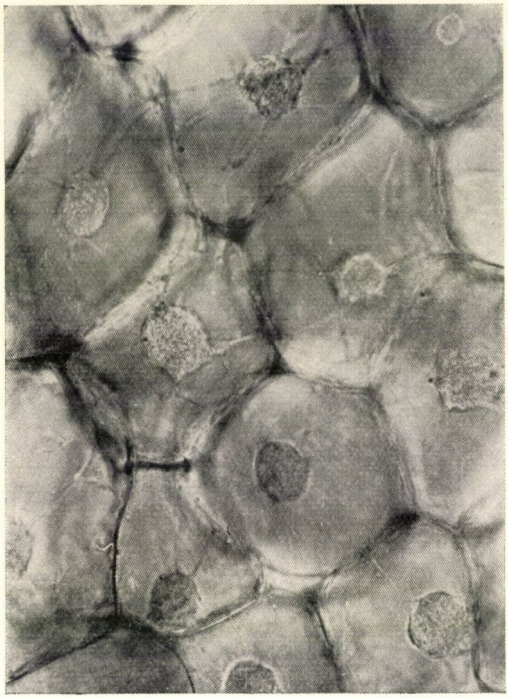

Fig. 2. Close-up of the living protoderm of the cotyledon of seedlings treated from the seed stage. Magnification c. 400 ×

formed here, in the seedlings the meristematic character of the basal cells is less observable in proportion to the increase of colchicine treatment. This shows that on one hand no divisions are observable in the seedlings while on the other the proportion of cell to nucleus size is four times as great here as in the control. An examination of the shape of the cells reveals that while the control is characterized by elongated cell forms, the seedlings are dominated by rather isodiametrical cell forms. If these are viewed from above, cells nearing a circle are also formed, implying the loss of the unidirectional polarity or at least its conversion into radial polarity (Figs. 1 and 2). In the seedlings even the cytoplasm configuration was strikingly dissimilar to that of the control so far as the nucleus — if spatially conceived — is suspended in the vacuole by a radially-structured plasmathread system (Fig. 2). The location of the cytoplasm threads and the direction of flow in them frequently changes, sometimes in every moment. The circulation of the plasma of the seedling was generally more active than that of the control. From this we concluded that colchicine reduced plasma viscosity which agrees with the statements pertaining to other plants and made by WADA (1940) and WEISSENBÖCK (1949).

In addition we used a polarizing microscope to check the transformation taking place in the submicroscopic structure of the cell wall. As it is known the microfibrils forming the skeletal framework of the wall of the plant are incorporated systematically, i.e., more or less parallel with each other, into the individual cell wall lamella and thus optically speaking the cell wall is anisotropic. This is also manifest in the protoderm of the untreated bulb seedlings, since the tangential cell walls between crossed nicols in a diagonal position are usually bright (Fig. 3). By using Red I compensator plate it can be stated that the course of the microfibrils in them is perpendicular to the longitudinal axis of the cells. The tangential walls of the colchicine-

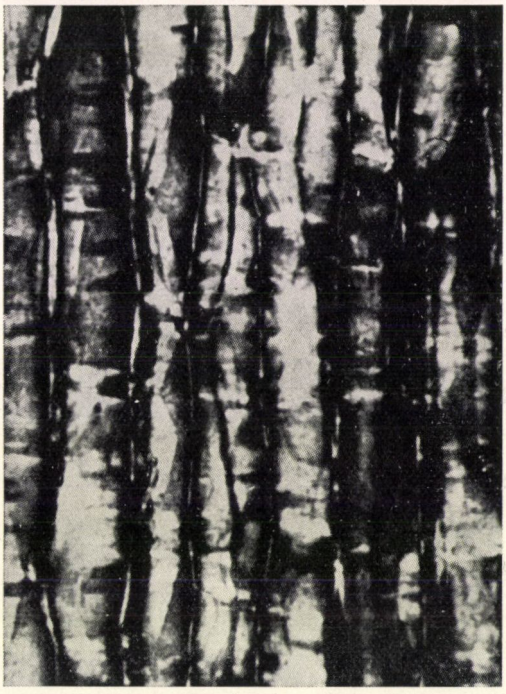

Fig. 3. Shot of the protoderm of the cotyledon of an untreated seedling with a polarizing microscope. (Between crossed nicols in a diagonal position.) Magnification c. 400 ×

treated protoderm cells are dark between crossed nicols even in a diagonal position. Thus they are not of birefringence type (Fig. 4) which indicates that the microfibrils are not parallelly oriented. Only the radial walls are bright but this only shows the lamellate condition of the cell walls.

According to our present knowledge it can be assumed and supported by, among others, GREEN's studies (1963) on green algae that the arrangement of the microfibrils of the cell wall must be attributed to the external outermost layer of cytoplasm which must also have a structure organized in such a way. Thus as it has been noted in the previously described experiment the effect of colchicine on the formation of the structure of the cell wall has to be — in our opinion — of indirect nature. We assume that colchicine has primarily inhibited the structural orientation of cytoplasm. This assumption is supported by the long-known fact that the mitosis-inhibiting effect of colchicine is based on inhibiting the development of the spindle in the nucleus, an oriented cytoplasmic structure. Even the reduction of the viscosity of the cytoplasm of the treated cells can be similarly interrupted. If all these are considered — bearing in

Fig. 4. Photograph with a polarizing microscope of the protoderm from the cotyledon of a seedling treated from the seed stage. (In a diagonal position between crossed nicols.) Magnification c. 400 ×

mind the simultaneous interference of cell polarity (which is proved by the fact that the cell forms become more isodiametrical) — and in agreement with the results of other authors, we may state that there is a close relationship between polarity and the structure of cytoplasm. Then our study seems to prove the theory that the essence of cell polarity is found in the basic structural organization of cytoplasm.

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THE FIRST HUNGARIAN LITERARY REPORT ON THE AGRICULTURE IN THE USA

In the second half of the 19th century Béla Széchenyi spent some time in the USA in order to study the social and economic situation prevailing there. In Hungary the feudal social system and the corresponding economic structure started to be replaced by feudal capitalism after the war of independence of 1848. The spiritual elite of the Hungarian society have soon perceived that the bourgeois form of society that had come to existence in the USA, is more free and more developed and the corresponding economic structure is more productive than that in our country. Széchenyi was particularly interested in the correlations of the social and economic situation and had studied these correlations in detail in the course of his travellings.

In the description of his journey published in 1863 under the title "My Journey in America" he analyses, primarily, these correlations. It was bourgeois development and industrialization in which Széchenyi took interest because in those days European agriculture and thus also Hungarian agriculture were at a higher level than the American farms and farmers who had to toil hard on areas that had been cleared of forests. And yet, to a certain extent, through Széchenyi's book we get insight also in the USA agriculture of those days, therefore, it is with right to consider him a Hungarian agricultural expert who had first studied the agriculture of the USA which, though not yet developed in those days, had displayed much novelty especially the application of machines.

By the beginning of the 19th century the bourgeois revolution resulted in the liquidation of the feudal social system in several countries of Europe. In Hungary, too, the productive forces underwent considerable changes. Though in a limited way only, industry too, began to develop. The production of goods increased by leaps and bounds. The industrial and commercial capital began to develop and along with it came to existence that minimum of bourgeoisie which could be the basis of transforming the social conditions. The work of Széchenyi got into the hands of his readers at a time when — though the great national uprising had been crushed by power — in the spirit of people there lived the indomitable striving after national independence and along with it the longing for economic and cultural progress.

We get acquainted with the life and activity of Béla Széchenyi through the book of Lajos Lóczy: B. Széchenyi was born in 1837 and was educated abroad (Berlin, Bonn). On May 6, 1896 he was conferred upon the "ad honores" doctor's degree at the Pázmány Péter University, Budapest. Following the example of his father István Széchenyi, he had travelled almost all over Europe and then in 1863, together with Gyula Károlyi (1837—1890), he went to America. It was that journey on which he wrote the above mentioned work. Széchenyi's book is a diary-like itinerary. As he puts it, he wanted to give expression to his own opinion, however, in a manner that would make his readers acquainted with the American conditions. His report consists of explaining the peculiarities experienced there but he also submits statistical data which might be considered right in respect of the conditions of the 1860-ies.

When describing the development of the Union it becomes evident that the American citizens got, almost in a ready state, everything that had been gathered by the Europeans throughout long centuries (experience, science, inventions). Those who have come to the new country have availed themselves of the scientific and technical achievements using same as basis upon which they could build further on.

In his book he speaks on the agriculture of the USA as follows: "The flora is extremely exuberant and this is showed not so much in the extension of the jungles than rather in the great choice of the kinds of plants (in their forests almost all kinds of trees can be found, e.g., in oak alone there exist more than 40 varieties while in Hungary there are only 21 of them). The luxuriance of vegetation is due to the water supply being available unlimitedly. Everywhere, in all directions, there are wonderful navigable rivers of a width surpassing all imagination, running creeks, bubbling springs, numerous ponds." (Quoted from p. 65.) The fertility of

Table 1

Plant growing (1860) and animal breeding (1850) in the free states

Name of crops	Bushel	Dollar
Wheat	72,157,486	108,236,229
Oats	96,590,071	38,636,148
Maize	242,618,650	145,571,190
Potato	59,033,140	22,432,604
Clover	762,265	2,286,795
Hay*	28,427,799,680	142,138,998
Wool*	39,647,211	13,876,523
Butter, Cheese*	349,860,783	52,479,117
Animal breeding	**Piece**	
Horse	3,589,584	
Pig	11,904,085	
Donkey, Mule	118,191	
Milk-Cow	5,300,851	
Draught Ox	1,063,789	
Sheep	16,253,640	

*pound

the soil is about the same as in Hungary. Their farm buildings are built cheaply but being practical, machines are used for all operations. The farms had been gained from the wilderness and, occasionally, there still protrude from the earth the blocks of the trees felled It is but slowly that the farmers can make these stumps disappear, and decades are required to have the fields cleared of them. The cattle in America is of English origin and there are a great many flocks of sheep. In the southern and western parts of the country horse breeding is extremely developed; see Tables 1, 2.

From the data of the two Tables the structure and volume of USA agriculture can be established. When analysing the data it becomes evident that animal breeding has the leading role (growing fodder plants, producing cheese and butter). Within the frame of animal husbandry the breeding of pigs and sheep is of main importance. And yet, his experiences in the agriculture of the USA could not exert particularly great effect on Béla Széchenyi since, as I have already mentioned, Hungarian agriculture — concerning productivity — has surpassed that of America. Thus, though being an expert in agriculture, he rather turned his attention on industry in the course of his American trip. In that field he was able to gain much more experience. It is worth while mentioning that in the agriculture of the USA there work many machines. (The effect of mechanization on increasing production showed itself at the beginning of the 20th century only. Then it was that the capital made its way into agriculture; the European wars had here no effect whatsoever, and since the War of the North and the South there has been no war in America).

Table 2

Plant growing (1860) and animal breeding (1850) in the slave states

Name of crops	Bushel	Dollar
Wheat	27,904,476	41,156,714
Oats	49,882,799	19,953,191
Maize	348,992,282	209,395,369
Potato	44,847,420	17,042,019
Clover	123,517	370,551
Hay*	2.548,636,160	12,743,180
Wool*	12,197,329	4,479,065
Butter, cheese*	68,634,224	10,295,133
Animal breeding	**Piece**	
Horse	2,525,874	
Pig	20,652,182	
Donkey, Mule	1,011,362	
Milk Cow	3,428,611	
Draught Ox	1,176,286	
Sheep	7,064,116	

*pound

The experiences gained in industry and, in general, in the development of technics — being either of social or of agricultural character, — must have made deep impression on him as is shown by the following quotation:

"If I wanted to mention the state of their hospitals, mental asylums and prisons, their cemeteries and factories, the purposefulness of their cranes as well as their hay- and cotton stamping machines, the refrigerators, the promenades, etc., — I could do it only with the utmost appreciation.

Their brilliant inventions achieved one succes after the other. The thousands and thousands of machine samples of the Washington Patent Office prove this. The sewing-, boot-, and ship manufacturing machines have recently been followed by a milking- and typesetting machine."

The book is endowed with the special value that whatever he sees he immediately tries to compare it with the conditions prevailing at home and through the impressions gained there he wages, critically the ways and manners of developing the possibilities available in his country. These observations are which show that the author, with his wide-ranging economic and political knowledge, suggests almost definite directives in order to make his country prosperous. Thus he says with the economical perception of vast perspectives: "If we want to introduce anything in Hungary, we ought to copy always the best achievements; in every respect we are lagging behind to such an extent that we must take over from elsewhere what proved to be useful there; — we needn't do anything in too great a hurry because no surplus money is available to spend for experiments in a wasteful manner."

In the interest of economic prosperity and to defend same, he more than once is strongly against the immature political manifestations which have often hindered development. "It is but a recent symptom — he says, — that in our country political trends are always involved in everything to such an extent that even porters and cartmen are included and made to join this or that political group."

The work of Béla Széchenyi is imbued with the endeavour to help the Nation; that effort is summarized in the most beautiful and the most expressive way in the last lines of his book: "Every citizen of Hungary might have his share in prompting and raising the economic development of this country; nobody's activity or goodwill should be hindered: those who cannot work spiritually, might work with their hand; and those not in the position to do so, might perhaps, help with money."

He gives evidence of his far-reaching, deep and wise way of democratic thinking when at the end of his exposition, he draws the following comparison: "One cannot determine in a building which brick is of higher value or which of them is on its right place; all are needed to that whole building so that it should stand; the brick that forms a part of the basement wall under the ground invisible by anybody, is neither less unworthy nor less useful than the one that holds the rafter of the roof though the latter is placed higher and seems to be nearer the sky than the other."

The itinerary of Béla Széchenyi was instructive for his contemporaries since it made them acquainted with that overseas country which, up till then, had existed in their imagination only. The book also gave a comprehensive picture on the society-social and cultural as well as economic and technical constructions which became the firm bases of the quick rise of the American people.

This book is of value even today because it can be considered the first report written in Hungarian on the agriculture as well as on the social and cultural conditions of the USA, and at the same time, from the description based on real statistical data, we are able to reconstruct — with more or less certainty — the man, the society and wealth of America at the middle of the 19th century.

E. Puhr

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RESEARCH WORK ON HYBRID WHEAT AT MARTONVÁSÁR, II

As continuing a previous publication (Rajki, E.—Rajki, S. 1966) in the present paper authors report on certain results obtained in their further investigations referring to the plasmic male sterile and fertility restoring genetic system as well as to the estimation of heterosis to be expected with wheat.

1. The *timopheevi*-type A_2, A_3, A_4, A_5 and A_7, as well as the *caudata*-type A_1 and the *ovata*-type A_6 plasmically male sterile sources and all the three restorer sources, among them a Wilson-type restorer of sterile plasm that had been examined first of all, proved to be stable and

efficient both in the greenhouse and field experiments performed in 1965—66. The investigations continue to be carried out mainly in *T. aestivum* L. and partly *T. durum* Desf. winter wheat varieties. Initial efforts are made for including rye, *S. cereale* L. and other cereals into the male sterile and restorer program, respectively.

The well-combining wheat varieties to be made plasmically male sterile and restorer, respectively, are for the time being in BC_4 (Ms X^5 and Rf X^5). Especially in the Ms-program, the habitus of certain sub-lines does not differ at all or to hardly any extent, from that of the recurrent varieties, while their male sterility seems to be good for practical utilization. In the Rf-program the effect of the lax ear of the restorer source prevails to some extent in Rf X^4, too. In the greenhouse in certain Ms × Rf combinations the rate of grain-set has attained the mean grain setting values of the varieties. In field-sowings the results of similar investigations will be submitted, for the first time, after this year's harvest and the working up of the material.

Special attention deserve certain Ms plants that have been produced with the *caudata*-type A_1 pollen sterile source. Contrary to the previous BC generations, it is in this year that we have first succeeded in producing Ms plants of normal vitality by using the A_1 pollen sterile source. This fact might be of importance to our entire hybrid wheat program since, as it is known, (RAJKI, E.—RAJKI, S. 1966) to produce male sterile and restorer analogues of the well-combining wheat varieties — with promising result, — was possible through the *timopheevi*-type source only.

The aim of the recently started program with the rye varieties included, is to produce male sterile rye and open flowering male sterile wheat, being now in Ms Wheat[2] and Ms Rye,[2] respectively.

Table 1

Differences in the yield of the parent varieties and of the F_1 hybrids. 1956/57

Variant		Weight of grain / plant g $\bar{x}$	P		F_1	
			B 1201	EBH	B × EBH	EBH × B
P	B 1201	11.37	—	−1.24	+2.94□□□	+2.36□□
	EBH	10.13	−10	—	+4.18□□□	+3.60□□□
F_1	B × EBH	14.31	+26□□□	+41□□□	—	−0.58
	EBH × B	13.73	+21□□	+36□□□	−4	—

Table 2

Differences in the yield of the parent varieties and of the F_1 hybrids. 1956/57

Variant		Weight of grain / plant g $\bar{x}$	P		F_1	
			B 1201	Knyezsa	B × K	K × B
P	B 1201	11.37	—	− 0.01	+ 2.33□□	+5.99□□□
	Knyezsa	11.36	0	—	+ 2.34□	+6.00□□□
F_1	B × K	13.70	+20□□	+21□	—	+3.66□□
	K × B	17.36	+53□□□	+53□□□	+27□□	—

2. Prompted by the outstanding heterosis effect of one of our combinations (RAJKI, E.—RAJKI, S. 1966), we disclose some previous test data on the combining ability of F_1 — and partly F_2, as well as F_3. The F_1 data generally refer to 40—60, in the last combination shown in Tables and Figures, to 80—120 plants, being treated individually and that had been sown at a spacing of 16×5 cm. The F_2 and F_3 data refer to trials made with machine-sowing. In these trials the plot-size was 28.77 m², being laid out in seven serial lattice squares. The experiments were made with two Hungarian varieties (*Bánkuti 1201* and *Fleischmann 481*, in the Tables and Figures *B 1201* and *F 481* or *B* and *F*), with two varieties from the USA *(Early Blackhull* and *Kanred* × *Fulcaster*, *EBH* and *KF)*, with one from Canada *(Marquis, M)* and a Bulgarian variety *(Knyezsa, K)*.

Table 3

Differences in the yield of the parent varieties and of the F_1 hybrids. 1956/57

Variant		Weight of grain per plant, g, $\bar{x}$	P		F_1	
			B 1201	Marquis	B × M	M × B
P	B 1201	11.37	—	+1.14	+1.37	+2.23□
	Marquis	12.51	+10	—	+0.23	+1.09
F_1	B × M	12.74	+12	+2	—	+0.86
	M × B	13.60	+20□	+9	+7	—

Table 4

Differences in the yield of the parent varieties and of the F_1 hybrids. 1956/57

Variant		Weight of grain per plant, g, $\bar{x}$	P		F_1	
			EBH	F 481	EBH × F	F × EBH
P	EBH	10.13	—	+ 0.58	+2.87□□	+1.57
	F 481	10.71	+ 6	—	+2.29□□	+0.99
F_1	EBH × F	13.00	+28□□	+21□□	—	−1.30
	F × EBH	11.70	+16	+ 9	+10	—

Table 5

Differences in the yield of the parent varieties and of the F_1 hybrids. 1956/57

Variant		Weight of grain per plant, g, $\bar{x}$	P		F_1	
			Knyezsa	F 481	K × F	F × K
P	Knyezsa	11.36	—	− 0.65	+0.53	−0.33
	F 481	10.71	+6	—	+1.18	+0.32
F_1	K × F	11.89	+5	+11	—	+0.86
	F × K	11.03	−3	+ 3	−7	—

Table 6

Differences in the yield of the parent varieties and of the F_1 hybrids. 1956/57

Variant		Weight of grain per plant g $\bar{x}$	P		F_1	
			B 1201	KF	B × KF	KF × B
P	B 1201	11.37	—	− 2.51□□	+3.56□□□	−0.49
	KF	8.86	−22□□	—	+6.07□□□	+2.02□
F_1	B × KF	14.93	+31□□□	+69□□□	—	−4.05□□□
	KF × B	10.88	− 5	+23□	−27□□□	—

Table 7

Differences in the yield of the parent varieties and of the F_1 hybrids. 1957/58

Variant		Weight of grain per plant g $\bar{x}$	P		F_1	
			B 1201	F 481	B × F	F × B
P	B 1201	7.06	—	+ 0.51	+1.51□□□	+1.46□□□
	F 481	7.57	+7	—	+1.00□	+0.95□
F_1	B × F	8.57	+18□□□	+12□	—	−0.05
	F × B	8.52	+17□□□	+11□	−1	—

Table 8

Differences in the yield of the parent varieties and of the F_2 hybrids. 1958/59

Variant		Grain yield kg $\bar{x}$	P		F_2	
			B 1201	F 481	B × F	F × B
P	B 1201	14.34	—	+0.12	+0.59	+1.17□
	F 481	14.46	+1	—	+0.47	+1.05□
F_2	B × F	14.93	+4	+3	—	+0.58
	F × B	15.51	+8□	+7□	+4	—

Table 9

Differences in the yield of the parent varieties and of the F_3 hybrids. 1959/60

Variant		Grain yield kg $\bar{x}$	P		F_3	
			B 1201	F 481	B × F	F × B
P	B 1201	12.14	—	+0.07	−0.11	+0.09
	F 481	12.21	+1	—	−0.18	+0.02
F_3	B × F	12.03	−1	−1	—	+0.20
	F × B	12.23	+1	0	+2	—

Certain combinations showed outstanding (31 and 53%, respectively) and P = 0.001 also significant yield surplus, i.e. heterosis as compared with the standard variety *B 1201* (Tables *2* and *6*). The combinations were *B 1201* × *Knyezsa* and *B 1201* × *KF*.

It is worth while to mention that in these two combinations at the levels P = 0.01 and 0.001, respectively, significant differences in yield could be established between the F_1 hybrids

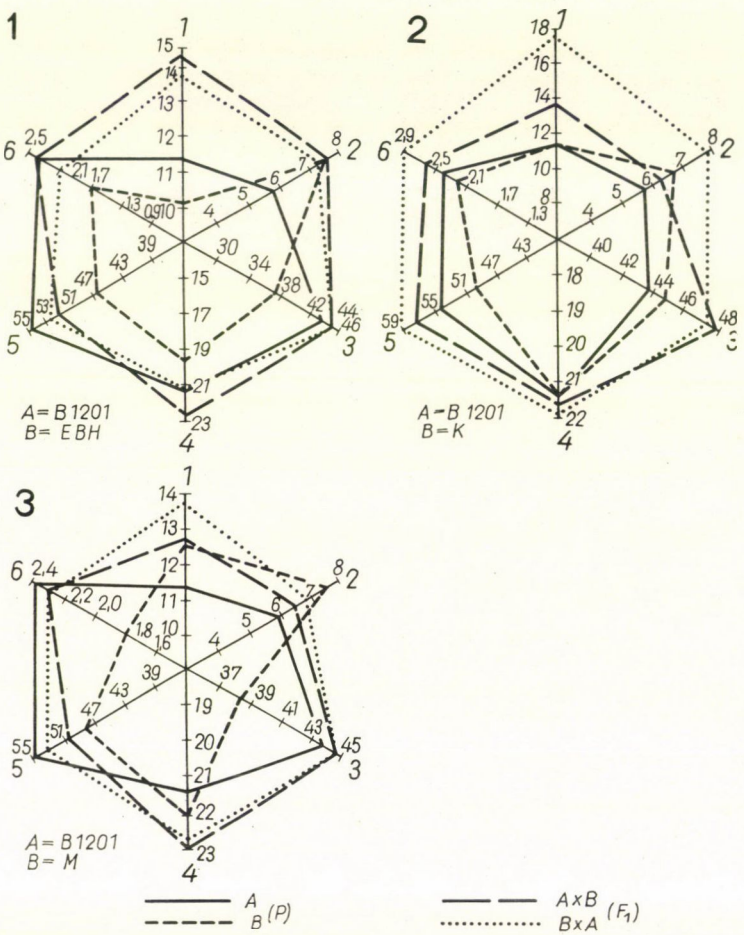

Fig. 1—3. Some properties of the parent varieties and of the F_1 hybrids. 1956/57, (1. Weight of grain/plant, g; 2. Productive tillering, piece; 3. Weight of 1000 grains, g; 4. Spikelet/main ear, piece; 5. Grain/main ear, piece; 6. Weight of grain/main ear, g)

of direct and reciprocal crossings. In the case of other combinations — *B 1201* × *EBH*, *EBH* × *F 481*, *B 1201* × *Marquis* and *B 1201* × *F 481* — the heterosis effect was less (26, 21, 20 and 18%), however, at the levels P = 0.001, 0.01, and 0.05, respectively, it was significant (*1*, *3*, *4* and *7* Tables). In an F_1 combination — *Knyezsa* × *F 481* — no significant difference in the yield or heterosis effect can be proved between the standard parent variety and the F_1 hybrids (See Table *5*).

Of the yield elements in certain cases the stronger productive tillering, sometimes the higher number of grains/plant or the value of the thousand grain weight, and again in other cases two or all the three elements together formed the basis of heterosis. (See: 1—7 Figures!)

3. With one combination — *B 1201 × F 481* — in direct and reciprocal crossings, besides F_1 also in F_2 and F_3 the yields of the parent varieties and of the hybrids have been compared.

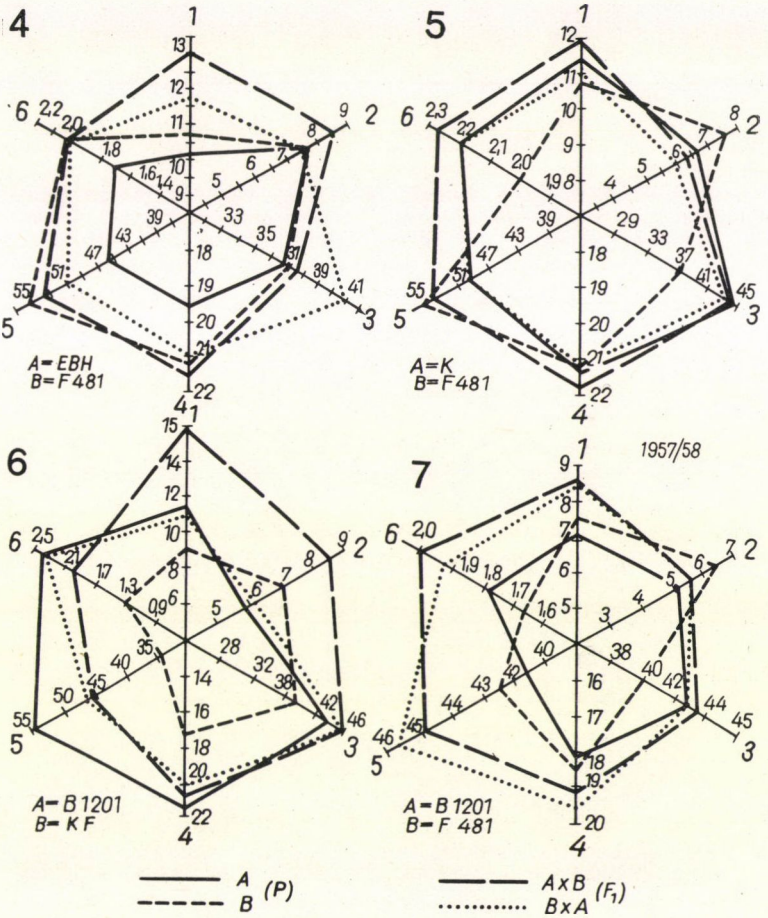

Fig. 4—7. Some properties of the parent varieties and of the F_1 hybrids. 1956/57, and 1957/58, respectively (1. Weight of grain/plant, g; 2. Productive tillering, piece; 3. Weight of 1000 grains, g; 4. Spikelet/main ear, piece; 5. Grain/main ear, piece; 6. Weight of grain/main ear, g)

From Tables 7—9. it can be seen that in F_1 at the levels $P = 0.001$ and 0.05, respectively, significant differences in yield were obtained between the standard parent varieties and the hybrids. In F_2, however, significant yield-differences at the level $P = 0.05$ could be established with the reciprocal hybrid only as against the parent varieties. As to F_3 the yield-differences have disappeared, in other words, there was no difference between the yields of the varieties and hybrids. Essentially, this agrees with the results of similar investigations made by ENGLEDOW—PÁL (1934), HARRINGTON (1940), SIKKA *et al.* (1959) and STUBER *et al.* (1962).

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VARIETAL SYSTEMATICS OF CHICKLING VETCH (LATHYRUS SATIVUS L.)

Although the *Lathyrus* L. genus contains manifold species and chickling vetch belongs to the oldest cultivated plants, the variability range of the species is poor. The most complete enumeration of the intraspecific taxa is found in the book of ASCHERSON—GRAEBNER (1906—1910). The first rather complete discussion in Hungarian (MÁNDY 1943) has used the data partly of this work and partly of HEGI (1924) specifying mostly the taxa important from the point of view of plant production.

According to ASCHERSON—GRAEBNER (1906—1910) the most important varieties are the following:

var. *amphicarpus* (L.) Coss. an ecologically interesting varietas in the eastern and southern regions of the Mediterranean. Its flowers with rudimentary corolla develop in the soil where its fruits ripen as well.

var. *angustatus* Sèr. (= var. *stenophyllus* Boiss.) with only narrow leaves (1.5—3 mm wide) and with short peduncled flowers not larger than 1.2 cm. (HEGI 1924).

var. *obtusatus* (Alef.) A. et G. on the lower leaves of which the folioles are elliptic while on the upper ones broad-lanceolate. Grows wild in Spain.

var. *stipulaceus* Willk. with considerably elongated stipulae which are either longer than the petioles of all leaves or only than those of the upper ones.

The rachis is thread-like thin and longer than the leaf. A native of Spain.

HEGI (1924) introduces also the following variety:

var. *pseudocicera* Schust. which in its formation is very suggestive of the species *Lathyrus cicera* L. but the wing plates of its rough stems are much wider and also its sheath more pinnate.

The earlier system (ASCHERSON—GRAEBNER 1906—1910, HEGI 1924) did not organically insert the cultivated varieties into the system published but referred to these as to the forms (f. *albus*, f. *coloratus* and f. *coeruleus)* of the species. MÁNDY (1943) deemed it necessary to group the forms into the taxon var. *communis* My. In conformity with the newer rules of nomenclature the latter classification has been revised, enlarged and the more important varieties ranged into the modern varietal system. The system of the cultivated varieties is the following:

convar. *communis* My — cultivated chickling vetch. The provars and varieties ranged here are the following:

provar. *albus* (A. et G.) My. The flowers and seeds are white (at most the latter are of a pale yellowish, greyish or greenish shade). The plants are 50—70 cm high. Varieties (in brackets the place of origin):

Blanche de Maroc (GDR)
C. 53—54 (Cyprus)
Elin Pelin (Bulgaria)
I. C. 423 (USSR)
Karcagi (Hungary)
Kinalsky 7 (USSR)
Kraftborn (GDR)
Krasnodarskaya 1 (USSR)
Krasnodarskaya 55 (USSR)
Sadrinskaya (USSR)
Saranskaya mestnaya (SSSR)
Sennaya 1122 (USSR)
Stepowy (GDR)
Stepnaya 12 (USSR)
Stepnaya 21 (USSR)
Stepnaya 287 (USSR)
Stepovoya (USSR)
"*Tarnaszentandrási*" local variety (Hungary)

provar. *leucanthus* My. The flower is white, the seed brown. Variety: *Borovo* (USSR).

provar. *coloratus* (Sèr.) My. The corolla is white but interwoven with blue or red veins. The seed is light or dark brown spotted. Variety: *Tarpeskaya* (USSR).

provar. *roseus* My. The flowers or only some petals are pink. The seeds are whitish or of pink hued. Variety: "*Krim-Cherson*" local variety (USSR) (the seed originates from Berlin).

provar. *coerulescens* My. The corolla of the flowers is light blue, the seeds white. Varieties:

"Acsai" local variety (Hungary)
Ariana (Bulgaria)
Favetta (Portugal)
Golubka (USSR)
Gorohovidnaya (USSR)
Hesa Buntblühende (= Giessener Bunte Platterbse; GDR)
I. C. 77 (India)
Lentille de Espagna (Portugal)
T. 4103—1 (India)

provar *coeruleus* (A. et G.) My. The corolla of the flowers is bright blue, blue or violet. The seeds are smaller, marbled with dark brown. Cultivated mainly in India, Ethiopia and North Africa. Varieties:

*

Canberra City (Australia)
Cicharo (Argentine)
Egypt (Australia)
I. C. 4 (India)
I. C. 1651 (India)
Sanganak (Iran)
"*Szentesi*" local variety (Hungary)
T. 5005 (India)

Prepared by the National Institute of Agrobotany, Tápiószele.

GY. MÁNDY

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MÁNDY GY. (1943): A szegesborsó. (The Chickling Vetch.) Köztelek. **43,** 48. Sep. 1—8.

THE HISTOCHEMICAL INDICATION OF ALDEHYDES IN THE VOLATILE OIL CANALS OF CORIANDRUM SATIVUM L.

The histogenetic examination of the volatile oil canals of coriander must be accompanied by the histochemical examination of the contents of these canals. According to the data of CARLBLOM (1936) approximately 95% of the volatile oil of the green coriander is composed of aldehydes. According to the study of REISCH *et al.* (1965) 60—80% of the volatile oil of the overground part of green coriander is composed of a mixture of aldehydes which can be precipitated with dynitro-phenylhydrazine and determined by column-chromatography. As it is known the aldehydes react with phenylhydrazine forming phenylhydrazone; these are crystalline compounds slightly soluble in water. The aldehydes similary react with such derivatives of phenylhydrazine in which different substituents are linked to the phenol radical. The hydrazones gained from dinitro-phenylhydrazine are characterized by their easy crystallization (BRUCKNER 1954). The 2.4-dinitro-phenylhydrazine is used for the indication of aldehydes in thin-layer chromatography (generally 5 μg of aldehydes are applied to the layer) (STAHL 1962). Yellow or orange spots indicate the presence of aldehydes.

Sensitivity, ability to crystallize and in view that the compounds are coloured make it advisable to try 2.4-dinitro-phenylhydrazine as a histochemical reagent. The reagent has been made according to STAHL's (1962) prescription, i.e., 0.4% of 2.4-dinitro-phenylhydrazine was dissolved in 2 N hydrochloric acid. The solution can be kept for a long time. The precipitate separating upon standing was filtered immediately before using.

The volatile oil of coriander not yet flowering was distilled by steam and then checked how it behaved when adding the reagent. At first the reaction was slow on account of the hydrophobic property of the volatile oil, but 2—3 minutes later a brown crystalline precipitate separated on the slide. The oil of the ripe fruit, 66—80% of which is linalool (a tertiary alcohol) does not react. If the section of the coriander stem is placed in 2.4-dinitro-phenylhydrazine, a brownish precipitate will appear in the volatile oil canals. If the oil does not become smeared when making the section the brown crystalline precipitate is visible only in the canals, otherwise it is formed elsewhere, too. The reagent stains the lignified cell walls rust-brown in 1 or 2 minutes while the non-lignified cell walls are not dyed. In the cross-section of the stem of the anise used as control no precipitate separates under the effect of the reagent for as it is known the volatile oil of anise contains anethole in large quantities and this is not an aldehyde. If we do not examine freehand sections but ones made with freezing microtomes, when freezing the material, we should then use a honey-thick solution of gum arabic as an auxiliary (SÁRKÁNY—SZALAI 1964), which solution may be preserved with carbolic acid. The mucilago gummi arabici has been prepared according to *Pharmacopoea Hungarica* (1954). The cross-sections have been placed immediately into the reagent, the mucilago gummi arabici does not interfere with the reaction. If the preparations are wanted to be made permanent the coverslips must be mounted to prevent the solution from evaporating and so that the crystals of the surplus reagent should not separate. Synthetic enamel paint was quite useful for this purpose.

The histochemical reaction has also been tested by thin-layer chromatography, but this is beyond the scope of the present study and has to be treated in a future work (LASSÁNYI—LŐRINCZ: Test on terpenoids present in parts of Coriandrum sativum L. II).

Thus my study shows that the hydrochlorate solution of dinitro-phenylhydrazine is suitable for the histochemical indication of aldehydes in coriander oil.

*

Prepared by the National Institute for Agricultural Quality Testing, Budapest.

ZS. LASSÁNYI

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A PLEA FOR INTERNATIONAL COOPERATION AND COORDINATION OF VARIETY TRIALS

Results of the First International Symposium on Plant Variety Trials

The National Institute for the Qualifying of Variety and Breeding Techniques in Agriculture initiated a symposium, the first of its kind, held in Budapest at the Hungarian Academy of Sciences between June 6 and 8, 1966. After the opening speech of PÁL LOSONCZI, Minister of Agriculture, the introductory presentations were given by S. KAPÁS, director of the host institute, by K. S. NAZARENKO, All-Union Deputy-Minister of Agriculture in the Soviet Union and by J. A. HOGEN ESCH, Assistant Director of the Institute for Variety Trials in Holland. After the plenary session the following authors read their papers PFEIFFER, C., STEINECK, O., TELEKI, S., WENZL, H. (A); MITKOV, T., MURATZOV, T. G. (BG); CSERNYENKO, M. K., DYANELIJE, V. S., GODUNOVA, K. N., KAPCINEL, M. A., KOTOV, A. F., KRESTNYIKOV, A. D., STARCHENKOVA, M. V., ZAKOLOGAJNY, V. I. (USSR); FORAL, A., POSPISLOVA, D., ROD, J., SCHMIDT, J. (ČS): BECKER, H., BRAUN, H., FISCHBECK, G., GEIDEL, H., HAUFE, W., HERRMANN, PH., HILLMANN, H. D., HÜBNER, R., v. KAMEKE, D., v. MÜLLER, A., NAUMANN, G., v. ROSENSTIEL, KL., RUNDFELDT, H., SIEVERS, E. (GFR); BÄTZ, G., BURGHAUSEN, R., EHRENPFORDT, V., ENDERLEIN, G., FÜRSTE, K., GALL, H., GRIESSE, I., MEINEL, A., MIHATSCH, H., MÖBIUS, H. J., NEUMANN, D., RÜTHER, H. and KOSS, U., SCHULZE, J., THOMAS, E., WUTZIG, H., ZIMMERMANN, K. F., ZWICKER, R. (GDR); BERTHET, R., ETCHEBARNE, J. (F); ELLIOT, C. S. and HORNE, F. R., EMECZ, T. I., SMITH, L. J. (GB); ANTAL, J., BALLA, L., BARABÁS, Z., BARADA, L., BÁLINT, A., BEKE, F., BERKÓ, J., BLASCSÓK, GY., BÓCSA, I., CSELŐTEI, L., EIFERT, J., Mr. and Mrs. E. BÁLÓ, GÄRTNER, K., HINFNER, K., JÁNOSSY, A., KANIZSAY, J., KAPÁS, S., KATONA, J., KISS, Á., KISS, I. E., KOMJÁTHI, I., KOZMA, P., LELLEY, J., LIGETI, L., NÉMETH, L. and TOMCSÁNYI, P., O'SVÁTH, J., PENYIGEY, D., PETHŐ, F. and BUBÁN, T., RAJKI, E. and RAJKI, S., ROSTA, K., SÁRVÁRI, I., SVÁB, J., SZABÓ, M., SZERAFIN, J., TAMÁSSY, I., TASNÁDI, E., TÉTÉNYI, P., TOMCSÁNYI, P., WELLISCH, P., ZACHÁR, GY. (H); FENAROLI, L., PIACCO, R., ROFFI. R., TINARELLI, A., (I); VELDHUYZEN VAN ZANTEN, J. E., VERDOOREN, L. R. (NL); BILSKI, E., DOMCHOWSKI, K., DZIECOL, W., PIECHOWIAK, K., VIRION, J. (PL); MANNER, R. (Finland); BULA R. J. (USA) and REPANSEK, V. (YU).

Approximately 102 foreign experts from 14 countries and c. 300 Hungarian experts participated in the sessions. The freely-chosen topics centered around the following general themes in the order given: 1. general significance and organization of variety trials; 2. methods of variety trials held under field conditions; 3. horticulture; 4. fruit and grapes; 5. variety preservation, variety degeneration; 6. potatoes; 7. legal problems of variety protection and 8. breeding, genetics. In addition, two films were shown on the mechanization of plant breeding and potato production in France. The representatives of several countries reported on plant breeding and growing, production for conservation, state control, the particular organization and system of variety trials and recognition, the national network of experimentation and situation in international experimentation. The participants spoke about their research on

cereals (winter wheat, hybrid wheat, rye, triticale, barley, rice, sorghum), maize (variety, hybrid, silo), sugar beets, potatoes, fodder plants (lucerne, clover and grasses), horticultural plants (cabbage, tobacco, mustard), fruit varieties and viniculture and their work, results, suggestions and requirements concerning these latter two or they described how useful their methods proved to be in these cultures.

The most general phenomenon noted during the Symposium was the general spread of the *polyfactorial principle* and the *need for the complex study of phenomena.* Authors treating the most diverse themes claimed that in experimentation it is necessary to study and evaluate not only the yield but also as many of its components as possible (as well as supplementing them with studies carried out in the laboratory, greenhouse and climatic chambers). The various criteria of development must be used in proving quantitative differences but the variability of every measurable or examinable property is important especially for breeding and variety recognition. Several authors emphasized the importance of *adequate arrangements.* The method of examination of variety experimentation may be regarded as a multi-stage selection and as the examination is proceeding, the employment of different arrangements may be useful. Polyfactorial arrangements must be given greater emphasis than before in order to reveal the differences in genotype. Polyfactorial experiments are also indispensable for horticulture. Because of the increasing prominence of the polyfactorial approach and economic aspects the defining of the *response surface* should be focussed on.

The *complete, ecological characterization* of varieties seems necessary whenever it is possible. In addition to the examination and treatment of growth and development the environmental (pedological, climatological) factors ought to be increasingly respected. The countries involved in production should be fully informed about the results.

In case of fruit, grapes, and horticultural produce most affected by changes of value according to quality and season the *contracted economical values* proposed by Hungary came into general use. In addition to productivity a single index should be used for the values expressing both qualitative properties and expenditures. The breeder should evaluate several factors of yield from an economic angle, too.

The lecturers discussed the *economy of the individual experiment* as well as the *series of experiments.* The great number of localities and years is more important than the large number of replicates in an experiment. Several contributions treated how we can conclude for the optimal allocation of experimental resources from the adequate experimental stock. For the sake of economy they suggested the introduction of "composite design" and of the non-ortogonal trials and polyfactorial experiments without replicates.

The automation of data processing is indispensable in these versatile studies necessitated by modern research. Researchers must be well prepared for using the most modern methods; they must become very familiar with the possibilities provided by technology and must overcome their reluctance to using such methods. It is important that punch cards and electronic brains may be used in the experimenting agricultural institutes themselves. The best results can naturally be achieved by high-power computers. For the sake of automation it is desirable to *typify* and *mechanize* future experimentation as far as possible.

The international control of the varieties was treated in accordance with the "Paris Convention". It has been manifested that the international and economic solution of the problem of varieties cannot be carried out without solving the legal issues involved. Should the Symposium have failed to find a solution to these it would — however — be advisable *to coordinate the study of national and foreign varieties as well as to use a uniform method.* The more precise the breeder is in carrying out his tests, the less rigid will be the process of variety experimentation.

After the three-day conference the participants were introduced through field trips to the practical work of variety trials in Hungary.

J. O'SVÁTH

THE EFFECT OF VARIOUS ANTI-METABOLITE IN THE COURSE OF VERNALIZATION

Many authors have studied the relation of nucleic acids and vernalization. KONAREV (1954) find a higher RNA content during the vernalization of winter wheats. MARKOWSKI—MADEJ (1962) observed also on the spring forms the change in the examined P fraction due to cold. No quantitative differences were found by FINCH—CARR (1956) between unvernalized and vernalized plants in content of DNA and RNA in winter rye. GÜNTHER (1963) reported on similar results on compounds containing P especially RNA and DNA. The latter authors did not find an essential difference between the spring and winter forms or rather the observed changes were not characteristic of vernalization. Both suggested the possibility of the synthesis of specific nucleic acids.

Many authors demonstrated the relationship between the photoperiodic induction and RNA or DNA (BOPP 1965). Less data are available on vernalization. DÉVAY (1965) used various inhibitors (Natrium arsenate, tripaflavin, acridin orange, Chloramphenicol, $AgNO_3$, DNP) demonstrated that the biochemical mechanism of vernalization is partially connected with the metabolism of nucleic acid. SUGE—YAMADA (1965) observed the inhibitory effect of 2-thiouracyl on winter wheats and this makes probable the relation between vernalization and RNA.

In the present paper I would like to present the results obtained while the inhibitors were being dosed during the various phases of vernalization. *B 1201* winter wheat was used as subject. The young plant (at the two leaf stage) was vernalized at 2° C on an 8-hour day lenght in a climatic chamber. The degree of vernalization or rather the extent of inhibition was measured by the time of the appearance of the flower primordia (day-lengh 16 hours, at a temperature of 17° C) (DÉVAY 1965). The vernalization requirement of *B 1201* winter wheat in the plant stage at 2° C in short day (8 hours) is 28—30 days (DÉVAY 1965).

The inhibitors in the form of a fine spray were applied at the 1st, 7th, 14th, and 21st days of vernalization, then the cold treatment was continued ower a period of seven days. Afterwards all the plants were kept for further days at 15° C and then they were grown on long day at 17° C until the appearance of the flower primordia. At the beginning and the end of and immediately after the 6-day cultivating at 15° C (i.e. the stabilization of vernalization) antimetabolite treatments were used for the elucidation of the possible processes involved in the stabilization of vernalization. The measurements of inhibition were compared to the control plants treated with distilled water.

The results of the experiments are summarized in Fig. 1. The antimetabolite concentrations use did not cause more than a 20% inhibition of growth.

The inhibitors of nucleic acid and protein synthesis showed a different effect in the various phases of vernalization. A strong inhibition was found when 2-thiouracyl at the beginning of cold induction, and during the photoperiodic induction was used. The most intensive thioacetamide inhibition occurred during the first few days of cold induction. Low concentrations of digitonin (a disorganizer of mithochondrium structures) at the beginning of vernalization stimulated the vernalization and during stabilization showed a strong inhibition. Chloramphenicol inhibition was evidenced primarily during the middle phase of vernalization although a definite inhibition could be observed at the beginning of the induction period when a higher concentration was used.

On the basis of the effect of the inhibitors it can be concluded that during vernalization specific RNA synthesis takes place at the beginning of cold induction. This is followed by the synthesis of probably also specific proteins whose existence was demonstrated in previous publications (DÉVAY 1965a, 1965b, 1966). The effect of thioacetamid and digitonin points out the need for the examination of the role of the nucleolus and the mitochondria.

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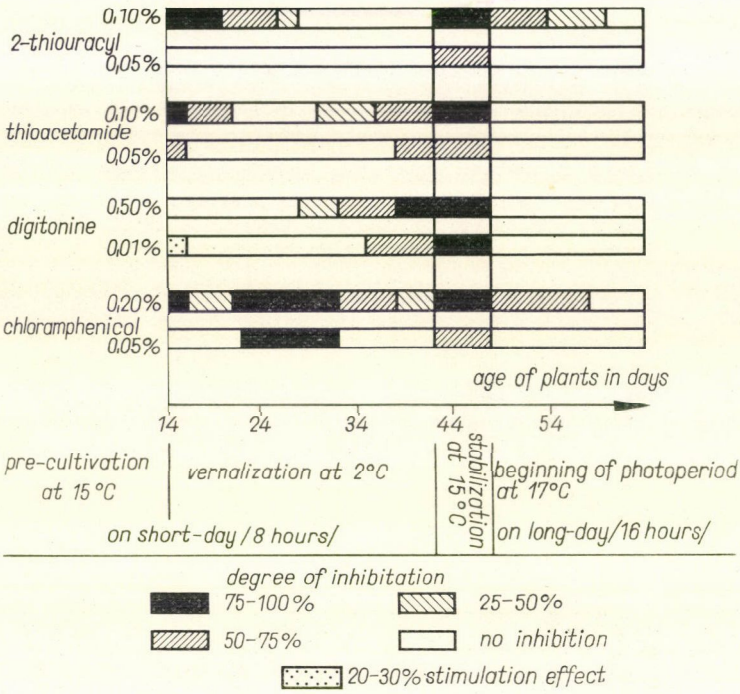

Fig. 1. The Effect of Different Metabolic Inhibitors in the Processes of Vernalization (vernalization of green plants)

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Prepared by the Agricultural Research Institute of the Hungarian Academy of Sciences, Martonvásár.

M. Dévay

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CYTOLOGICAL EXAMINATION OF THE DIFFERENTIATION AND FUNCTIONING GLANDULAR HAIRS OF MELANDRIUM ALBUM

The glandular hairs on calyx of *Melandrium album* (Mill.) Gracke are composed of a developed form of basal cell, a few cylindrical stalk cells and a single, spherical, head-like glandular cell. In the cytoplasm of the cells of the stalk there are large vacuoles and the flowing cytoplasm contains several chloroplasts. The head-like glandular cell is completely filled up with a thick, apparently granular yellow cytoplasm unlike the stem cells.

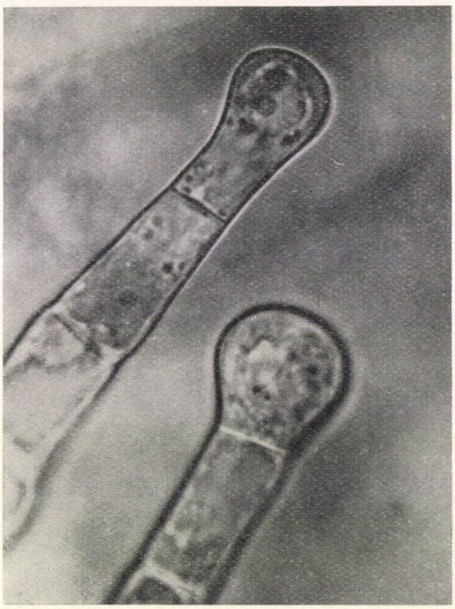

Fig. 1. Developing glandular hairs. In one of them we see the apical cell in the initial stage of becoming round. Magnification c. 800 ×

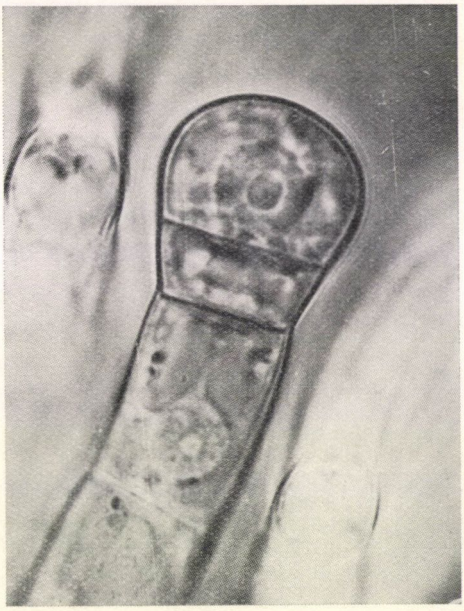

Fig. 2. Inequally divided apical cell. Magnification c. 800 ×

First we have examined the differentation of gland cells and in particular the role of inequal division in the living cells during this process. We have *discovered* that differentiation begins with the movement of the nucleus to the apical portion of the terminal cell of the developing glandular hair, then the apical portions of the cell gradually become rounded (Fig. 1). Simultaneously the volume of the nucleus and nucleolus also increases. Once the terminal cell of the hair assumed a small, head-like shape an inequal cell division is taking place resulting in the development of a larger cell at the apex and a smaller one at the stalk (Fig. 2): further only the larger apical cell will develop into a glandular cell and the smaller one becomes a stalk cell containing chloroplasts. The nucleus of this latter becomes similar to those of the other stalk cells. From this it has been concluded that the peculiar growth taking place in the terminal cell of the developing hair, i.e., the rounding-off in the apical section of the cell, is not an immediate antecedent of the formation of the actual gland cell. The differentiation of the gland cell is the consequence of the mentioned inequal division. This circumstance agrees with the results of several other examinations according to which the development of new cell types is due to inequal division (Bünning 1958, Uphof 1962, Bloch 1965).

The second part of our examination treats those structural changes (also in vivo) which are related to the start of the functioning of the gland cell or rather which can be noted during the process of secretion. In this regard it should be first of all mentioned that the nucleolus becomes considerably larger; this is likely to be related to the beginning of the intensive production of the cell. (Fig. 3). In the following, elongated, needle-like crystals appear in the cytoplasm forming frequently clusters (Fig. 4). Crystal formation may be regarded as the sideproduct of the peculiar metabolism of the gland cell.

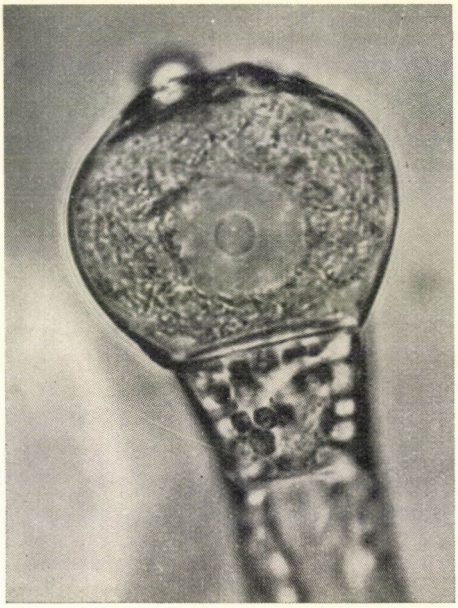

Fig. 3. Functioning glandular cell with very enlarged nucleolus. Magnification c. 800 ×

Fig. 4. Functioning glandular cell containing crystals. Magnification c. 800 ×

At the beginning, the crystals have a swaying motion showing that the cytoplasmic matter is also in motion. This seems to suggest a less viscous state of cytoplasm. As soon as secretion sets off through the cell wall the visible motion of the cytoplasm ceases and apparently a perfect state of motionlessness sets in. Microcinematographic shots of the gland cells were taken in this state (one picture every four seconds). When projecting the film at normal speed (22 pictures per second) we obtained an acceleration of approximately 100 times. The accelerated microcinematographic shots proved that the entire substance of the apparently motionless cytoplasm was in a very intensive state of motion. Neither the seed nor the quality of this motion can be equated with the rotary or circulatory plasma flow; it seems to be a swaying and somewhat irregularly swirling motion. The plasma motion microcinematographically is characteristic of the functioning gland cells and it is possibly related to the secretion of mucous.

*

Prepared by the Department of Applied Botany and Histogenesis L. Eötvös University and Instrumentation Service of the Hungarian Academy of Sciences

L. Fridvalszky, J. Nagy, Z. Nemes

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LÉDECI BETA ŐSZI ÁRPA

(Winter Barley Lédeci Beta)

Taxonomic place: Hordeum vulgare L. convar. *vulgare* MSF var. *parallelum* Körn. (MANSFELD 1950).

Origin: developed from a local variety of Csongrád county with individual selection.

Beginning of breeding: 1935, Sopronhorpács.

Breeders: † KURT SEDLMAYR, ANTAL CSITKOVICS, Sopronhorpács; variety maintaining breeder: GÉZA GRÁTZOL, Sopronhorpács.

State qualification: first certification 1944, first entry into the state register 1947: state registered improved variety (KAPÁS *et al.* 1965).

General characterization: dual-purpose six-rowed fodder barley (which, however, develops more poorly and yields less in spring seeding), medium winter-hardy (hardly suffers damage under snow cover), of rapid development, early ripening, productive.

Morphological description:

Root system: vigorous, deeply penetrating.

Shoot system: in autumn-seeding of rapid initial development and vigorously tillering, of dense stand, but in spring-seeding its development is protracted and although

more poorly tillering its stand is thinner and the lateral shoots rarely develop ears. Its early growth type is of prostrate character.

Stem: 108 cm on the average (ranging between 104 and 117 cm), long, vigorously developed but liable to lodging (value: 1.9—2.7; 5 = perfectly stable). The nodi are cylindrical. The ear-bearing internode below the ear runs straight, on the apex the "collar" is of closed "A"-type (ÅBERG—WIEBE 1948).

Foliage: dense. The leaf-blade is broad (15—22 mm), of medium green colour, linear-lanceolate. The leaf sheath naked, waxed. The flag leaves broad, short, their blade twisted; the ear is directly above. The auricles of the uppermost leaves are of red (anthocyan) colour at earing.

Ear: bending down, sometimes irregularly six-rowed. Mean length 6.8 cm. The awns are very long (even the lower ones reaching the apex of the ear), similarly to the ear are straw yellow, only the apical part is of dark red shade. Every spikelet of the ear awned; the awns rough to the end. The ear uniformly filled with spikelets, their number is 25—47. On the basal part the number of sterile spikelets is generally 4. In ripe condition the spikelets are shedding. The rachis runs straightly, the edge of its members is glabrous, the lower one short and straight. The glumes are narrow, awn-shaped, on their apex at the plate a longer beard. The plate of the glumes is glabrous. Grain weight per ear 1.6—2.0 g.

Caryopsis: is covered by lemmae. The grain with lemma is large, full, wide spindle shaped. Its colour is straw yellow, its surface glabrous. Thousand grain weight is 39.7 g on the average (ranging between 36.2—45.3); hl weight 61—69 kg (HORVÁTH 1957, 1963). In the grains the digestible protein is 6.9—8.6 per cent, starch value 65—73 kg.

Biological characters:

Germination: its cardinal points: minimum 4° C, optimum 10° C, maximum 40° C. The period of germination in the optimum is 3—4 days. Dormancy of seed depending on seeding date 59—88 days (MÁNDY 1966).

Vegetation period: from seeding to earing 244 days (ranging from 235 to 255 days) from seeding to waxen ripeness 262—269 days. A readily adapting variety but of late development (ripening) (HORVÁTH 1963, MÁNDY 1965).

Development: in autumn-seeding rapid and vigorous, still its shooting, earing and ripening is medium late. In spring-seeding development is protracted, therefore autumn-seeding is more advantageous (HORVÁTH 1963, KAPÁS *et al.* 1965).

Winter hardiness: medium. Winter killing may be without snow cover 32—43%, under snow cover 2—24 per cent (HORVÁTH 1954, 1957, 1963). Thinning out during the winter is compensated by the development of many lateral shoots (KAPÁS *et al.* 1965).

Resistance to diseases: sensitive to mildew, medium resistant to loose smut (KAPÁS *et al.* 1965).

Demands on farm technology:

For *seeding* the favourable period is in Hungary beginning of October (MÁNDY 1965). Seed requirement 2—2.5 million germs per cad. hold* (KAPÁS *et al.* 1965). In excessively early seeding the stand will be luxuriant and winter killing is more considerable. Tolerates late seeding readily.

For *soil* moderately demanding but best yielding on good wheat soils. On soils poor in nutrients utilizes chemical fertilizers (particularly N-fertilizer) very readily (KAPÁS *et al.* 1965).

Productivity in autumn seeding higher. One of the most productive Hungarian varieties. Straw yield may range from 27.5 to 41.8 q/cad. hold,* grain yield from 11 to 23 q/cad. hold.* Grain to straw ratio: 29—40 per cent: 60—71 per cent (HORVÁTH 1954, 1957, 1963).

1 cad. hold = 1.422 acres

Growing district: May be successfully grown on the whole territory of Hungary (KAPÁS *et al.* 1965).

GY. MÁNDY

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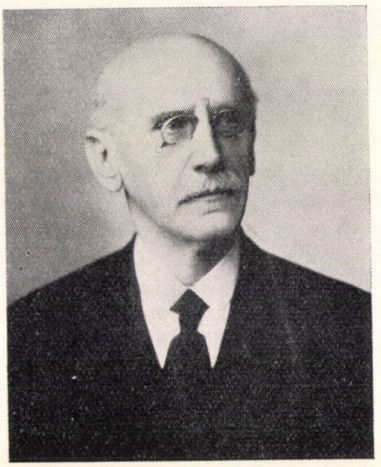
CHRONICA



ÁGOSTON ZIMMERMANN
(1875—1963)

Ágoston Zimmermann, Kossuth prize-winning academician, retired university professor, honorary doctor of the Veterinary College, honorary member of the Natural Science Society, of the Anatomische Gesellschaft, and of the Royal College of Veterinary Surgeons, London, possessor of the Order of Labour, died in Budapest after a long illness on October 6, 1963 at the age of 88. With his death the Hungarian Academy of Sciences lost its nestor and the Veterinary College and Hungarian and international scientific circles lost an outstanding, respected member.

Ágoston Zimmermann was born in *Mór* on December 3, 1875. He finished his veterinary studies in 1895 with excellent marks and in 1896 he began government service. First he was a demonstrator at the Veterinary Academy, then in 1903 he became an assistant teacher. In the same year he became doctor summa cum laude at the Faculty of Arts. In 1904 he earned his qualification as honorary lecturer at the Veterinary College while in 1910 at the Faculty of Arts in comparative anatomy and embryology of vertebrates. He participated in study tours abroad: he was at the Institutes of Anatomy in Berlin, Dresden, Giessen, Vienna and at the zoological station of Naples. In 1910 he was appointed the successor of Prof. Béla Nádaskay as professor of anatomy and embryology at the Veterinary College. During his professorship he was made the head of the Dept. of Zoology of the University of Budapest. He was also a lecturer at the Dept. of Biology and Earth Science of the University and in addition to this at the Dept. of Agriculture of the Faculty of Economics. Here he received the title of university professor. In 1933 he became Rector of the Veterinary College and on this occasion he received the highest distinction for his outstand-

ing work in the field of veterinary science and education. In 1939—1940 he became the Rector of the József Nádor University of Technology and Science. Earlier he had been president then, at the centenary, honorary member of the Natural Science Society. When he received the Kálmán Szily award. In 1922 the Hungarian Academy of Sciences, after being recommended by Prof. Lenhossék, elected him a corresponding member, then in 1934 a regular member and in 1942 an honorary one. A member was he elected after the Liberation in the reorganized Hungarian Academy of Sciences.

He became an honorary member of the Royal College of Veterinary Surgeons, London, and of the Anatomische Gesellschaft (1952); a member of the National Council for Higher Education, the Experts' Committee of the National Museum; secretary-general and honorary member of the Hungarian National Veterinary Association, secretary of the International Veterinary Congress and vice-president of the International Zoological Congress. In 1953 the Presidium of the Hungarian People's Republic awarded him the Order of Labour. In 1965 the Eötvös University awarded him a "golden diploma", the Veterinary College a "diamond diploma" and in 1963 the Veterinary University presented him with an "iron diploma". In 1962 this latter institute conferred on him an honorary degree. In 1957 the Council of Ministers awarded him a Kossuth Prize.

In 1946, after half a century of excellent work in the field of education and research, Ágoston Zimmermann retired at the age of 71 but he continued to work in his field at the same strenuous pace.

He began his career as an anatomist with serious and thorough grounding. His devotion to science inspired him to do additional work. He was proud of his institute which, as he noted, seemed small in comparison to foreign institutes: nevertheless he became so attached to it in thought and work that —although national and international universities made him many offers — he could not be separated from his department which he had developed with devotion and great sacrifice and in behalf of which he had exerted his best efforts. He believed ceaseless, self-sacrificing, quiet and methodical work, thorough knowledge, order and discipline of work to be the factors which spur one on to completing a task and can teach a quiet, balanced life devoted to work.

As an educator he used to lecture on descriptive, comparative and topographical anatomy and on embryology. Under his direction a new spirit arose in the work of the institute. He extended the anatomy course to four terms. In the first two semesters he was teaching systematic and comparative anatomy and in the third and fourth semesters topographical anatomy and embryology.

His lectures were characterized by careful planning, organization, emphasis on the essential and a regular and constant survey of contemporary literature. He attempted to make study easy by encouraging the active participation of the students. He wanted them to understand the working of the living organism and to seek the conditions of life in this apparently dry morphological science. Besides descriptive anatomy there was always room for the biological method of discussion and views. Thus he raised anatomy above its mere descriptive aspects to a higher plane, to the level of an explanatory science. The well-built system of his lectures made allowances for the knowledge unavoidably necessary for both the practical activity and scientific research of the veterinary surgeon. With the aid of his educational principles formulated

throughout many years of experience he succeeded in teaching his students what and how and with what aim they had to learn.

He was conscious of the fact that the other disciplines are based on anatomy, so he taught it in a practicable way, selecting and grouping the material and emphasizing the important data. His lectures were clear, exciting, provocative, they held the interest of his students, who keenly concentrated on them and willingly or unwillingly were under the influence of his organically built lectures.

He used to say that "Lectures are made productive by practice" and for this reason he took them very seriously. He always participated in laboratory practice. This he regarded traditionally as his main duty. In such a way he got closer to his students while being able to assert his educational principles. As an able pedagogue he taught his students to work on their own initiatives, to be methodical, exact; the students attended his classes at the dissecting room not under compulsion but for the sake of interest and in order to foster their own knowledges.

To make teaching even more successful he set up a collection, a sort of museum which was acknowledged also in foreign countries. In such a way he realized the essential requirement in the teaching of anatomy: "What cannot be illustrated, ought not to be said."

His textbooks mainly treated comparative anatomy, embryology of domestic mammals. Thus the purpose of education was served primarily by his "*Háziállatok anatómiája*" ("The Anatomy of Domestic Animals" published in editions) the "*Anatómiai gyakorlatok*" ("Anatomical Practice" published in two editions) and his "*Fejlődéstan*" ("Embryology" published in three editions). For the same purpose and as the result of detailed experiments carried out on a high level at the institute he wrote his book entitled "*A házinyúl természetrajza és hasznosítása*" ("The Natural History and Use of the Domestic Rabbit") which was listed by the Institut International du Coopération Intellectuelle among the ten best works published in 1927. His books entitled "*A házimacska*" ("The House Cat") and "*A tengerimalac természetrajza*" ("Natural History of the Guinea Pig") and his anatomy of laboratory animals published in a collection are also the results of thorough study carried out on a high plane.

These works are not reproductions or dry listings. In them Prof. Zimmermann creatively adapted the data of literature to the results of his research work and to his personal knowledge and applied them in his works. His ability in systematizing his subject-matter was shown in his textbooks. Besides being highly scientific these textbooks were interesting, precise, and easy-flowing. He was a restorer of the Hungarian and Latin (Greek) anatomical terminology.

He treated his collaborators with great understanding but if needed he could show determination. Besides his research work he encouraged them to do the same and supported them in their work. Not wanting to restrict the development of their talents and initiatives. While selecting them with a sharp insight into human nature he sponsored all those who deserved it. He required his collaborators to have a thorough knowledge in the line and devoted, purposeful work in order to deepen this knowledge even more. In their work they should have moral earnestness, ethical principles, dependability and they had to do what was required for their work.

His students inherited from him and preserved a responsiveness and love for classical culture.

His scientific activity all-encompassing and versatile, included comparative, functional anatomy as well as embryology and histology. His prize-winning anatomical and histological studies of digital's organs formation in domestic animals, his articular and myological works solving primarily functional questions are of great significance. Among digestive organs he was concerned with the stomach, mainly with the folded stomach of ruminants. In addition to this the main focusses of his research were the examination of the functional morphology of the mammary glands, his comparative examinations of the veinal system, the pacemaker and conductor system of the heart and his constitutional anatomical examinations.

His scientific works — in addition to his books — number several hundreds most of them including the solution to some minor question. He used to say that the age of great discoveries in anatomy was over and for this reason he felt his duty to be concentrating on details.

The research work of his institute was centered about four important topics (partly in connection with doctoral dissertations): the domestic rabbit, house cat, guinea pig and canary. The results of these examinations were the above mentioned comprehensive works published in book form.

The significance of his research is shown by the fact that he raised the fame of veterinary science abroad as he took all opportunities to report on the results of his studies not only at Hungarian scientific forums but at congresses abroad, too.

The life of Prof. Zimmermann was straight and quiet. It was the life of a scientist devoted to his discipline and dominated by the love of science. The high standards of his works are stamped by their thoroughness, impartiality and the sharp criticism of both the literature used and of his own data. This was made possible by his complete command of the science of anatomy and his broad education based on his versatility.

His retirement meant merely giving up his department for his life continued on in the same spirit.

His object was determinate, he followed the regular course of life of a scientist in a straight line towards the goal which he set up for himself and which he achieved by diligent work.

His memory and the example he set will live on in the future, too. Only the forgotten person really dies. The memory of Prof. Zimmermann is preserved in everlasting reverence, sincerity, honor and love of his students, friends and of the Hungarian and international scientific world.

Gy. Kovács

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RECENSIONES

R. Soó: *Fejlődéstörténeti növényrendszertan.* (Phylogenetical Taxonomy.) Second revised edition. Tankönyvkiadó. (University textbook.) Budapest. 1963.

The second edition appeared exactly ten years after the first one, since this latter had been sold out and it became an urgent necessity to provide the university students with a textbook. Author has not changed anything in the structure of his system and even the extent of the first edition (560 pages) remained unchanged but it became possible to insert the new research results, changes in systematics and nomenclature into the corresponding parts. Author stresses that in the system of cryptogams, since this seems to be accepted, he did not modify anything, while in the systematical part on gymnosperms the arrangement has obtained a new form according to the considerations indicated already in the first edition. Systematics of angiosperms have been left unchanged since here without the regulation of a number of unsolved problems it is not timely to conduct an essential rearrangement.

The first original text of the phylogenetical taxonomy appeared as soon as 1947 in the form of university lecture notes. At that time the taxonomical system of BUSCH (1944) and GROSSHEIM (1945) constructed on the basis of similar considerations and concordant in the general outlines had not been known yet to the author. This is a good example showing that several authors independently from each other can arrive at similar realizations in the up-to-date systemization of plants. Still the author's systematic construction especially as to the origin of the amentaceous trees and in some phylogenetic details differs basically from the conception of BUSCH and GROSSHEIM since according to him monophyletic polytope origin is more probable.

Author also in the new edition of the book asserts the same basic idea that he has already accepted sooner as guiding principle. Thus he stresses that in his systemization he stands "partly by the teloma theory partly (concerning the flower) by the strobilar one".

In the systems that have come to light during the last decade the number of the orders and families of angiosperms substantially increased. In spite of that author refrained, for didactical reasons "from the otherwise justified decomposition of orders" and even out of families he discusses only the most important ones. In the preface he states that "thus we have left the system of our book essentially unchanged, only some groups of algae, the pteridophytes and the gymnosperms have obtained a new elaboration".

As to its structure the book is divided in two parts:

I. part: General phylogenetical taxonomy,

II. part. Special (descriptive) plant taxonomy.

In the first part discussion is opened by a historical introduction in which first of all the past of plant systemization is dealt with on the world-wide scale and the main systematical concepts presented; subsequently

the history and position of plant systemization in Hungary is approached. The following chapters discuss the guiding principles of the phylogenetical systemization of plants in the following order: "Foundations and Methods of Systemization", "Phylogeny of the Body and Organs of the Plant", "The Species Concept" and "Rules of the Nomenclature of Plants". In these chapters according to the author's terms we become acquainted with "the laws of the origin of species, groups and types, the idea of evolution, unity and struggle of inheritance and adaption, quantitative and qualitative changes arising, necessity of changes by leaps and bounds, etc."

In the second part is found the system of plants in a phylogenetic arrangement according to the author's conception. The series is opened by viruses *(Virophyta)* starting from the consideration that "since their detection it is still under discussion whether they are living beings." Then follows the system of plants divided in 14 phyla. These are the following.

Phylum I. *Shizomycophyta* (bacteria)
Phylum II. *Cyanophyta* (blue-green algae)
Phylum III. *Myxophyta — Monadophyta* (slime fungi, flagellates)
Phylum IV. *Euglenophyta*
Phylum V. *Pyrrophyta*
Phylum VI. *Chrysophyta* (yellow algae)
Phylum VII. *Chlorophyta* (green algae)
Phylum VIII. *Phaeophyta* (brown algae)
Phylum IX. *Rhodophyta* (red algae)
Phylum X. *Mycophyta* (fungi)
Phylum XI. *Bryophyta* (mosses)
Phylum XII. *Pteridophyta* (ferns)
Phylum XIII. *Gymnospermae* (gymnosperms)
Phylum XIV. *Angiospermae* (angiosperms)

The two last phyla (XIII and XIV) are also given the common name *Spermatophyta* (spermatophytes).

Within the phylum of Gymnospermae 3 subphyla and 7 classes are distinguished:

1. Subphylum. *Pteridospermophytina;* classes: *Pteridospermopsida, Cycadopsida,*

2. Subphylum. *Chlamydospermophytina;* class: *Chlamydospermopsida.*

3. Subphylum. *Coniferophytina;* classes: *Ginkgopsida, Cordaitopsida, Coniferopsida* and *Ephedropsida.*

The system of *Angiospermae* is divided into 2 classes and 4 + 2 branches the distribution of which is as follows:

Class A. *Dicotyledonopsida (Dicotyledones).*

Branch 1. *Polycarpicae — Rubiales;* the series: *Magnoliales, Ranales, Nymphaeales, Aristolochiales, Piperales, Hamamelidales, Rosales, Fabales (Leguminosae), Myrtales, Terebinthales, Celastrales, Rhamnales, Cornales (Umbelliflorae), Rubiales.*

Branch 2. *Malvales — Solanales;* the series: *Malvales, Geraniales, Euphorbiales (Tricoccae), Ligustrales, Gentianales, Boraginales (Contortae), Solanales (Personatae).*

Branch 3. *Rhoeadales — Asterales;* the series: *Rhoeadales, Sarraceniales, Cistales (Parietales), Theales (Guttiferales), Cucurbitales, Campanulales, Asterales, Ericales.*

Branch 4. *Caryophyllales — Monochlamydeae;* the series: *Santalales, Proteales, Caryophyllales (Centrospermae), Opuntiales (Cactales), Primulales, Plumbaginales, Ebenales, Polygonales, Urticales, Fagales, Juglandales, Myricales, Leitneriales, Balanopsidales, Salicales, Casuarinales (Verticillatae).*

Class B. *Monocotyledonopsida (Monocotyledones).*

Branch 1. *Alismatales — Poales;* the series: *Alismatales (Helobiae), Triuridales, Lilales, Zingiberales (Scitamineae), Orchidales (Gynandrae), Cyperales, Bromeliales (Farinosae), Poales (Graminales).*

Branch 2. *Spadiciflorae — Pandanales;* the series: *Arales, Arecales, Pandanales.*

The closing chapters of the book are the following: "History of Angiosperms", "Phylogeny and Ontogeny. Adaptive Phylogeny." "Phylogeny of the Vegetable Kingdom and Origin of Species." Finally follow the References and in the Appendix a review of the

names of drogues, index of Latin and Hungarian names of plants and other names.

The work supplies excellent information to all who are eager to learn, both to specialists and all interested in the systematic problems of plants.

GY. MÁNDY

J. DOMOKOS: *Dísznövénytermesztés.* (The Cultivation of Ornamental Plants.) Második javított, bővített kiadás. (Second revised and enlarged edition.) Mezőgazdasági Kiadó. (Agricultural Publishing House.) Budapest, 1963.

The Hungarian horticultural literature became richer by a valuable and — strictly speaking — a long-needed work when: "The Cultivation of Ornamental Plants" by J. DOMOKOS was published in 1961. Nothing proves better how those interested had needed and waited for this book than the fact that the first edition was entirely sold within barely a half-year, and soon the second edition had to be provided for. When trying to find the reason of that keen interest, the answer is very simple. Up to date there has not existed a comprehensive work on the cultivation of ornamental plants written in Hungarian.

Cultivating ornamental plants in this country used to compel the growers to read, for want of other, foreign literature this being mainly German and English. It was in these foreign books that they had to look after the problems coming up, and if somebody tried to be engaged seriously and intensively in that varied and far-reaching branch of cultivation, he must have noticed that there existed many a concept disagreeing with what he found in those foreign books. This, however, cannot be attributed to the sources being inaccurate; the reason is that the behaviour of ornamental plants cultivated in our transitional climate showing many continental and mediterranean characteristics, under our light- and temperature conditions, — is quite different. This is easy to understand mainly in case of our hardy tree plants and field perennials, however, with ornamental plants grown under glass throughout the whole year or in part of it — and those just being discussed in the book of DOMOKOS, — it is not so conspicuous. If, on the other hand, our light-conditions, the number of sunny days and the hours of illumination per day are taken into consideration, it will be easily understood that even this factor alone is quite different from conditions to be found elsewhere. And since it is just the photoperiodicity that plays an important role in the cultivation of ornamental plants, it will be realized by all that our experts have to reckon with that factor in case of glass-house cultures, too.

Besides the merit of having helped those interested to a special book written in Hungarian, another great merit of DOMOKOS is that in this book he has written up the experiences gathered during his practice of several decades. Though he availed himself of everything that could be adopted from foreign books, he reappraised that material to the smallest details applying it to home conditions. Even the pictures are photos taken entirely in this country supporting the material discussed very illustratively. It is the Hungarian specificity that is to be considered the greatest value of the book.

In the introduction the author expounds the principles of the discussion submitting also the reasons for them and dwelling on the specially Hungarian relations.

The work is divided into two parts. The first chapter of the "General Part" (pp 9—107) is "A Brief Review of the Notion and History of Cultivating Ornamental Plants"; in it, besides the determination of the concept, the author leads us along history from ancient times through the Middle Ages up to our days describing in full particulars the developing of our conditions, stressing the problems coming up after the liberation, our viewpoints and our development. The next chapter bears the title: "The Frames and Requirements of Ornamental Plant Growing", and within this, in a separate subchapter the author deals with the connection of "Climate and Working Conditions". It is in this part of the book in which

author explains that under our conditions, certain plants (e.g. carnation) cannot be kept in glass-house throughout the whole year, so mobile types of glass-houses being detachable, are here of great importance. Special care has to be bestowed upon ventilation and on equipments for shading because these differ considerably from the similar methods and equipments applied in Western European countries. Concerning field cultivation it must be taken into consideration that conditions in the western part of the Trans-Danubian district and on the Plains are considerably different; accordingly, the growing of pines and Ericaceae is reasonable only in West-Transdanubia this territory being cooler, and of higher relative moisture content. In the following subchapter called "Plant-Types", author rather makes suggestions instead of evaluating the data already available in our country. He considers specializing and the education of specialists as main requirement of largescale and quality growing. In his opinion the greatest problem lies in the lack of plants producing basic material for continued growing, and this he does consider necessary to be developed. In the subchapter with the title: "Guiding Principles for Establishing Cultivating Equipments", author speaks about the factors of rentability, using the least material for building purposes while ensuring the biological optimum, — this is his principle. In the subchapter called "Increasing the Profitableness of Cultivation", he expounds that abroad the possibility of same seems to be granted by mechanized production. Under conditions prevailing in this country, these possibilities are less available, on the other hand, we might economize by certain simplifications due to our climatic conditions. Viz., there exist many such plants in this country which, in a considerable phase of their development, can be raised also in the open. In the subchapter: "Qualities and Standards" the author writes about the above problem being over here but at an initial stage. This is followed by the subchapter: "Cultivating Vessels" in which he discusses first of all the relationships between cultivating vessels and root-types of plants.

The second chapter, "The Biological Factors in Growing Ornamental Plants", first discusses light, its effect and role, as well as that the number of sunny hours is in this country much higher than in western countries, — a fact considerably influencing green-house cultivation over here. Next he comes to the conditions of heat and finds that with the sunshine surplus it is higher than in the West. This as well as the regulation of heat is being discussed in details. The subject of the subdivision titled: "Water" is the role of water, quantity of the water used, problems of making it soft, moisture exhalation of the plant and regulation of same as well as irrigation. The subchapter called "The Soil" deals with the soils used for growing ornamental plants, the problem of humus, composting, and manuring, and finally, hydroponic cultivation.

The third chapter discussing on "The Biological Factors Being Efficient in Plant Growing", writes about "Plant Hormones" and their application, germinating-inhibiting materials and the phenomenon of allelopathia. In the subdivision entitled "The Course of Development in Plant Body", the consecutive changes during the individual plant development, developmental phases, photoperiodism, vernalization, heat and light requirements connected with the developmental phases, phenomenon of topophysis, of retinospores, of heterophyllia, formation of flovering, symptoms of deterioration and the effect of pruning are discussed from the view-point of ornamental plants growing.

Under the title "The Multiplication of Ornamental Plants" the different ways and methods of seeding, of propagation by cutting, of shooting and of grafting are written about. A special chapter is devoted to a brief summary of the most important information on the improvement of ornamental plants; the general part is closed up by a similarly brief chapter called: "Plant Protection in Growing Ornamental Plants".

The second part of the book (pp 109—304) writes in full about ornamental plants.

The cultivated species and varieties are in brief description enumerated, by genus; detailed descriptions are submitted on cultivation, commercial requirements, breeding aim and on the most frequent parasites and illnesses, respectively.

The author discusses his material in alphebetic sequence of the genus denominations as it is usually done in foreign books of similar character, meant for gardening experts dealing primarily with commercial ornamental plants. In what he says in the introduction (p. 5), viz.: "... the continuously changing taxonomic rangings fail to offer a reassuring, firm basis", — the author is right in so far as one witnesses just nowadays the age of revolutionary changes in taxonomy. All these were entailed by the results obtained through cytotaxonomic and cytogenetic research methods having brought about many a new thing after the methods based on outer morphology and histology applied so far. This has involved of course — changes also in the valuation of many taxa; mainly species and genera were to be contracted or divided; which showed itself also in the nomenclature by having the Latin names changed. Since all this mainly concerns — however — species and genera, while names and order of sequence of families are almost settled, author would have gained a considerably more reliable and firm basis through an enumeration according to taxonomic order of sequence than by the alphabetic one, the latter being much more labile. On the other hand, one can meet with taxonomic sequence in works being much more extensive and comprehensive, comprising also theoretical problems in details (like e.g. Pareys' Blumengärtnerei).

The otherwise excellent work unfortunately shows up some errors, too. I prefer not to discuss them all, this would have been part of the reader's scope of work. A few of them, however, I should like to mention. The cause of errors mainly lies in the fact that in many cases author deals with his subject quite independently from the botanical terminology; he uses expressions, previously reserved for other notions in botany, for properties that *have* got already other denomination. One of the most conspicuous errors is on p. 72, when writing about the *seasondimorphism* of the white poplar *(Populus alba)* thus calling the case of *heterophyllia* when — independently from the season!! — the leaves of shoots with long and short stalk-parts differ conspicuously from one another both in form and indumentum. The generally accepted idea of "seasondimorphism" is applied with such yearling species as *Melampyrum*, *Rhinantus*, *Gentianella*, etc. the different summer and autumn forms of which succeed one another during the growing season, depending on the season of the year. In the last paragraph on p. 65 he writes about phylogeny though from the text it becomes evident that he describes the different phases of ontogeny. It is with consistency that he calls the compound leaves parted leaves although in botany the expression "parted leaf" is something quite different.

Though in nomenclature author generally applies the new and up-to-date names, the denomination of garden variants and varieties is done in different ways, not uniformly or rather inconsequently; and when he acts on the basis of the valid international rules, he does not do so accurately.

All these regrettable errors cause doubt and misunderstanding in the reader who is well-versed in botany, among them in the very students of the author. It was a great pity not to allow the manuscript to be read by a botany expert beyond the two readers being gardening experts. Thus the embarrassing errors of that otherwise excellent and long-needed work could have been eliminated.

Z. E. KÁRPÁTI

F. GRUBER: *Rét és legelő.* (Meadow and Pasture.) Mezőgazdasági Kiadó. (Publishing House of Agricultural Books.) Budapest, 1959.

A considerable part — 14.5 per cent — of Hungary's area under agricultural cultivation is grassland, meadows and pastures. The condition of these, their technical use

according to destination may be in many instances open to criticism.

An objective judgement weighing all conditions cannot leave, however, out of consideration the factors that influenced the development of the present state of affairs. Of these the conjunctional conditions should be named in the first place which also in Hungary were leading to breaking up natural swards in a slower or more rapid rhythm and to their different utilization. It is a natural consequence of this process that the parts broken up and included in agricultural production invariably reduced the area of the best meadows and pastures.

The method of farming on pastures and meadows has been extensive up to the last decades and still is in many places, but this is partly due to given ecological conditions that cannot be changed for the time being. The climatic conditions of Hungary, particularly those of the Great Hungarian Plain *(Alföld)*, where the most extensive grasslands are found are only rarely favourable for ley-farming. Of the given continental climatic conditions prevailing in Hungary the amount and unfavourable distribution of precipitation and especially the low humidity in the summer months bring as soon as early in June to a standstill the life activity of herbage crops. Under such conditions even with intensive farm management ley farming comes to a deadlock unless there is a possibility of irrigation. Unfortunately, the hydrological conditions in Hungary are not favourable either, although in the last decade important investments have been made for better utilization of existing possibilities.

These adverse circumstances prompt us to search for ways and means to development of ley farming by adaptation to the special conditions of Hungary. Ferenc GRUBER, in his work on meadows and pastures, the first edition of which appeared in 1954 is also having the same end in view.

In Hungary — although the area belonging to this scope is comparatively large — literature on ley farming is far from being rich. This, too, indicates that it is not dealt with in the measures as would be justified by the proportion and importance of the area. The fact, however, that the first edition of GRUBER's work went out of print in a short time and, owing to the great demand, had to be published again in 1959 seems to point out that in this field not only work but also interest became livelier.

GRUBER, a well-known specialist of Hungarian grassland had already pointed out in the first edition of his book that he intended to help with giving compensation for these deficiencies and therefore he meant his work first of all to the men of practice. As a former professor of this special disciplines, breeder and research worker disposing of special knowledge acquired during several decades, he is well acquainted with the conditions of pastures and meadows also in practice. The second edition of his book may lay claim to an even greater interest than the first one as here he has filled the gaps that were left open in the first edition. Most important of these is that the present edition includes the results obtained in the various research institutes with the intensive work of the last ten years.

The second edition of GRUBER's book exceeds the first one both in contents and size; all problems encountered by specialists are treated uniformly, comprehensively and in their details in this book of 511 pages, abundantly illustrated by — mainly original — photos.

The book consists of nine chapters. In the first one the position of ley farming in Hungary, its history and trends in recent times are discussed generally. In the meantime the territorial data, however, required considerable correction since during the period between the first and second editions the area of meadows and pastures in Hungary had diminished by 124 thousand hectares, in the six years since the second edition up to now by another 115 thousand, thus a total of 239 thousand hectares and the process has not come yet to a standstill.

Chapter Two is distributed in two parts: the first deals with herbage grasses, the second with forage legumes *(Leguminosae)*. In these parts the general physiological,

morphological and botanical characteristics of plant species belonging to the group, conditions of origin in the most important species constituting the sward and process of their taking into cultivation are discussed. It contains considerably more material of knowledge than the corresponding chapter of the previous edition.

In the third chapter the morphological and botanical features of the most important bottom and top grasses to the tillering and rhizome or stolon producing type and of the most important legume crops occurring in the swards, their soil and water requirements and usefulness in farming are described. All characteristic features that enable the species to be identified are listed here, their fertilizer requirements are described and informations supplied as to what kind of turfing they are suitable to.

The fourth chapter deals with the use and care of grassland in general. It extends to the works of the care of swards, chemical weed control, swards of extreme soils such as sand, moor and alkali *(Szik)* soils, various fertilizers and methods of fertilizer application, time and methods of grazing, periods of cutting and up-to-date methods of haymaking. It should be stressed that this chapter deals in detail with the swards of the alkali *(Szik)* soils representing under Hungarian conditions a very considerable area and with the methods of their improvement. Under the conditions of Hungary also irrigation of pastures and meadows is of high importance. Therefore, this question is also thoroughly discussed with a description of special procedures, while the specific methods and their tools are illustrated with photos taken from the practice of farming.

In the fifth chapter the author deals with the most delicate task under Hungarian climatic conditions i.e. with the plantation or reconstruction of artificial swards — pastures and meadows. Here the principles covering the composition of seed mixtures for lawns of various destination are discussed including also those of special destination which do not strictly belong to agriculture.

In Chapter Six the importance of the turfy course of grass crop rotation aiming at improving the structure and indirectly the fertility of soils is surveyed in general.

Chapter Seven reviews an essential problem of grassland management, the production of grass seeds. After a discussion of the general situation in Hungary the conditions and works of the plantation of herbage and legume seed cultures are first surveyed and subsequently the general and special requirements of the individual species reviewed.

Chapter Eight is devoted to breeding. After a survey of the history of grass breeding in Hungary the present tasks and then the process for the propagation of foundation seed is discussed. This is followed by a survey of the flower structure of species and of biology of flowering, with enumeration of features per species the improvement of which implies the task of the breeder.

In Chapter Nine the plants of pastures and meadows are tabulated according to various features and References are given.

The work of GRUBER concerning its contents, method of discussion extending to all details, and illustrations is an important value in Hungarian agricultural literature. Although the Introduction points out that the book is meant first of all for the specialists of practical farming, it has achieved more than that by satisfying both practical and scientific requirements. Chapter Sixth, however, is open to criticism for as much as it does not discuss the problem in detail and as related to conditions prevailing in Hungary. Instead of surveying experience and results of research gained in Hungary and hence the methods and possibilities of application, it only treats the matter in general, though it would have served better the aim to elucidate the problem unequivocally in its relationship to Hungarian conditions.

The layout of the book, the opinions and method of discussion of the author are effectively holding to promote the realization of rational farming on grassland and hereby the author has fully attained his proposed aim.

L. TAKÁTS

A. PORPÁCZY et al.: *A korszerű gyümölcstermelés elméleti kérdései.* (The Theoretical Problems of Up-to-date Fruit Growing.) Mezőgazdasági Kiadó. (Publishing House for Agricultural Books.) Budapest, 1965.

This work has been published, under the editorship of Aladár Porpáczy, in a second, revised and enlarged edition. On 674 pages, with 170 Figures and 15 Tables it offers, using the most important foreign and Hungarian literature, a comprehensive picture on the theoretical issues of fruit growing. Technical relationships between applied physiology and fruit growing are analysed. The book fills a long felt lack in Hungarian special literature and plays at the same time an important part in international literature. Since the publication of Kobel's work no such manual has appeared that summarized the problems of fruit growing on similarly deep physiological grounds. The book is meant, first of all, for those engaged in ground and applied research but in its certain chapters practical growers find also many useful informations. The international literature on fruit growing being very large, the present book has, thus, its greatest merit in synthetizing part of the wide literary activities viz. the physiological questions in fruit growing. This way it affords an important help for the deeper knowledge of the response to factors influencing the growing of fruit bearing plants.

Part One supplies a deep analysis of the metabolism of fruit plants and of environmental conditions. In contrast to other special books on fruit growing that have appeared so far it attracts the reader's attention to the development of physiological properties the knowledge of which is only too needed in profitable fruit growing.

In this part Chapter Six, by which the second revised edition is enlarged, has a special interest. Here not only the physiological laws valid on the field of fruit production are discussed but by analysing new scientific statements concerning protein synthesis and RNS an immeasurable aid is afforded to research workers dealing with the improvement of fruit.

Illustrative representation of the structure and replication of DNS greatly facilitate the study of the book also for those less expert in this discipline. With the thorough discussion of the code ABC — one of the most brilliant achievements of modern biology in these last years — many scientific results are pointed out that may serve further great progress of the biological research work.

In the chapter on Problems of Resistance the difficulties of research on resistance, the possibilities of infection, the penetration of the parasite, the aggressivity of the pathogen and toxicological problems are dealt with, and an indispensable help supplied to specialists both of plant protection and of production. Here the results of the authors' research work are also imparted. So the statement bearing on the so-called apoplexy of apricots that connects — on the basis of their own finding — this disease causing many damages with pathogens e.g. with *Verticillium,* may mark a progress in the solution of the problems of apricot apoplexy. The resistance of the most important varieties of fruit species to various pathogens and pests is displayed in a Table with limiting values. This comprehensive elaboration supplies a guidance to specialists of breeding, plant protection and production alike.

Very valuable is the second part of the work where the growth and fruit development of fruit bearing plants are analysed. By a synthesis of broad Hungarian and international literature, attention is directed to the most important principles and tasks of fruit growing. Through seven chapters — from germination to the dormancy of fruit bearing plants and to senescence — analysis of the relationships between physiology and technics are placed into the focus of investigations. On these grounds answers are sought and given to many a problem of detail that influence the success of fruit growing in the relations between theory and practice.

Also Chapter Four of Part Two is outstanding where the problem of growth and development of fruit-buds is analysed.

When discussing new technical proceedings employed in intensive fruit growing

(dense planting, tying down of shoots) also some new statements are made in theoretical connection. E.g. when dealing with pruning on physiological grounds authors come to the conclusion that strong pruning applied year by year is injurious both for the beginning of bearing and life activities of the fruit-tree.

A novel presentation of the theory of carbohydrate to nitrogen ratio may reckon with interest.

No special book in Hungarian has discussed yet so profoundly the theory of thinning out of fruit with chemicals, its use, side effects and its whole action mechanism. The progressive statements of the work may help with obtaining more rapid results also in this field.

The book, at the end of each chapter, lists a wide scope of literature, a method facilitating the deeper study of the matter by those interested in particulars.

The usefulness of the book is enhanced by a Table of Contents in four languages: Hungarian, Russian, English and German.

The work of Porpáczy and co-workers beside offering a synthesis of Hungarian and foreign literature, with its rich material of knowledge and a discussion of own research work contributes not only to the more profound understanding of the theoretical problems of fruit production but supplies new ideas to research conducted in this field and further development of practical fruit growing.

R. Boros

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РЕЗЮМЕ

ДИФФЕРЕНЦИАЦИЯ УЛЬТРАСТРУКТУРЫ ОБОЛОЧКИ КЛЕТОК, ПОКРЫВАЮЩИХ ВОЛОСКОВ У CUCURBITA PEPO L.

Л. ФРИДВАЛЬСКИ

У *Cucurbita pepo* L. клетки покрывающих волосков или некоторые части их оболочки ввиду относительной крупности клеток хорошо можно препарировать с целью микроскопических исследований. Исследование очищенных и известного положения частей клеточных стенок поляризационным микроскопом показало, что боковые стенки нижних клеток, т. наз. клетки основания волосков в большинстве своем негативного двойного преломления, т. е. находящиеся в них микрофибриллумы располагаются в поперечном направлении. Двойное преломление боковых клеточных стенок других клеток, наоборот, оказалось позитивного характера. В последних клетках действительно было определено косое направление фибриллов, которое в некоторых ламеллах было чередующимся, и, таким образом, образовывалась перекрестная структура. Между перекрестившимися николами можно было наблюдать фибриллы, которые можно рассматривать как узлы (связки) целлюлозных микрофибрилл. Благодаря этим фибриллам удалось увидеть перекрестную структуру. Отклонение, которое наблюдалось в структуре оболочки клеток основания и остальных клеток, можно объяснить тем, что клетка основания растет более в ширину, другие же клетки — главным образом в длину. Силы, возникающие при росте в ширину, в основном сохраняют ориентацию исходных микрофибриллов. Однако при росте в длину микрофибриллы выходят из их первоначального положения и направления, клетка приближается к оси по длине. Клетки, образующие волосок, содержат крупные углубления в поперечных стенках, образование которых находится во взаимосвязи с интенсивными межклеточными связями.

ИЗУЧЕНИЕ РОСТА ТЕЛЯТ ДЖЕРСЕЙСКОЙ ПОРОДЫ, ВСКОРМЛЕННЫХ НА МОЛОКЕ И ЕГО ЗАМЕНИТЕЛЯХ

А. ДАРВИШ, М. К. СОЛИМАН

Настоящим изучением предлагается метод выращивания молодняка Джерсейской породы и развития жвачной функции в раннем возрасте. Это было выполнено благодаря введению сухого корма в диету, начиная с четвертой недели, когда жвачные функции начали развиваться, вместо кормления их только молоком. Диета была богата протеином и содержала необходимые минеральные вещества с небольшим количеством целлюлозы, т. к. сухие корма обычно отклоняются. Также давались свеже-скошенный зеленый корм, как молодой клевер, или тщательно нарезанная зеленая кукуруза. Имевшаяся для телят вода не ограничивалась (ad libitum) и молодняк привязывался близ своих матерей, чтобы иметь большую возможность для переваривания пищи, выроненной изо рта матери во время жвачки.

Постепенное кормление телят Джерсейской породы сухим кормом, наряду с молоком и зеленым кормом, хотя и увеличивало ростовые показатели и, следовательно, использованную крахмальную ценность, увеличивало также быстроту роста и экономию в цене живого веса на 18%.

По сравнению с коровами и буйволами местной селекции телята Джерсейской породы показали меньшие ростовые показатели и более высокий дневной прирост.

БИОХИМИЧЕСКИЕ ПРОЦЕССЫ ЯРОВИЗАЦИИ, VI
ИЗМЕНЕНИЯ СОДЕРЖАНИЯ ФИТОХРОМА В ПРОЦЕССЕ ЯРОВИЗАЦИИ

М. ДЕВАИ

Было изучено появление фитохрома и изменение его количества в процессе яровизации озимой пшеницы сорта Б 1201. Установлено, что активного фитохрома в неяровизированных растениях выявить не удалось. Формирование активного фитохрома наблюдается только во второй половине периода яровизации. Процесс света не требует. Под влиянием высокой температуры (30° Ц) наблюдается нефотохимическое превращение фитохрома: но только в определенной фазе процесса яровизации.

ВЕГЕТАТИВНОЕ РАЗМНОЖЕНИЕ УКОРЕНЕНИЕМ ОРЕХА СОРТА ФЕРТЁДИ Е. I

Й. ЗАТЬКО

Нами была испробована эффективность метода укоренения черенка привитого саженца ореха Фертёди Е. I, когда побег перед укоренением расщепляют у основания. Расщеп побега только в том случае был результативным, если у саженца предшествующей осенью с одной стороны обрезались корни, что облегчало его наклонение, а затем опускание в борозду глубиной 8—10 см; ствол и ветви покрывались землей, а весной побеги, развившиеся из почек, находящихся под землей, время от времени окучивали с целью получения этиолированных побегов, которые потом использовались для укоренения. Приготовленные в течение полутора лет таким образом черенки на низких местах с заболоченной почвой укоренялись на 52%, на песчанных почвах, склонных к высыханию — на 35%. На заболоченной почве часть побегов укореняется при покрытии их землей и без расщепления. 90% укорененных черенков, срезанных во время оценки, развиваются в жизнеспособные растения.

ВЛИЯНИЕ ПОЛОЖЕНИЯ И РАЗВИТОСТИ ЗАЧАТКА ПОЧАТКОВ КУКУРУЗЫ НА СОДЕРЖАНИЕ АЗОТА В ЯРУСАХ СТЕБЛЯ И ЛИСТЬЕВ

М. ПЕТЁ

Изучалось влияние формирования женского соцветия на азотный обмен веществ вегетативных органов, на основе изменений в процессе онтогенеза содержания азота в разных междоузлиях и ярусах листьев растений самоопылённой линии кукурузы.

Содержание белков в вегетативных органах существенно увеличивается в период от выхода в трубку до фазы молочной спелости. Поярусные различия существенны. Место расположения и развитость початка или отсутствие формирования зерна значительно влияют на содержание азота в вегетативных органах.

ВЛИЯНИЕ МЕТИЛТИОУРАЦИЛА НА ПРИВЕС КРУПНОГО РОГАТОГО СКОТА И НА КАЧЕСТВО МЯСА

Х. ТАНГЛ, З. КУНФФИ, М. ФАРКАШ

Препарат метилтиоурацила МЕЙКО западно-германского производства был испытан при откорме группы бычков венгерской пестрой породы (10 голов старше 1 года) с целью установления эффективности на увеличение привеса при одинаковых условиях кормления. Применяя препарат в течение 35 дней был получен привес в 65 кг, а привес контрольных животных составил 40,2 кг. После этого периода опытная группа животных получила нормальный рацион контрольной группы (без действующего вещества) и за 30 дней привесы были ниже привеса контроля.

По данным бойни и органолептических проб препарат улучшил и качество мяса, придавал ему более нежную консистенцию и лучшую окраску. Целесообразным кажется поэтому давать животным такой препарат в конце откорма, если после этого животные сразу поступают на убой.

ФАКТОРЫ, ВЛИЯЮЩИЕ НА КОЛИЧЕСТВЕННО-АНАТОМИЧЕСКИЕ СВОЙСТВА ЛОЗЫ ВИНОГРАДА

Влияние строения лозы и нагрузки куста

А. ХЕГЕДЮШ

Проводилось сравнительно-анатомическое изучение лозы подвойного сорта Берландиери × Рипария Т. 5С при различной нагрузке кустов. Выводилось 20 количественно-анатомических показателей путём измерений и подсчётов, проведенных на поперечных срезах середины междоузлия и вычисления соотношений различных прямых показателей. Изучалась изменчивость этих показателей по кустам, по числу и длине побегов, а также и по длине и толщине междоузлий.

Большинство изученных количественно-анатомических показателей проявляет достоверные различия по кустам, но и в других группировках проявляются различия между группами по ряду показателей. В зависимости от длины побегов только один из показателей проявляет достоверные различия (диаметр наиболее крупной трахеи).

Следовательно, при изучении влияния сортовых и экологических факторов на изменчивость количественно-анатомических показателей нужно взять все образцы с различных кустов, чтобы сократить ошибки, связанные с покустовыми различиями. Целесообразно, кроме того, брать образцы с кустов одинаковой нагрузки и изучать междоузлия средней длины и толщины, для сокращения индивидуальных отклонений и этим путём.

ВЛИЯНИЕ КИНЕТИНА НА СОДЕРЖАНИЕ ПИГМЕНТОВ В ЛИСТЬЯХ ЯЧМЕНЯ

М. ХОРВАТ, Д. ЛАСТИТИ

В листьях, поставленных в воду, спустя сутки уже наблюдался распад пигментов, по сравнению с зелеными листьями ячменя, выдержанными в растворе кинетина (водопроводная вода) концентрации в 10^{-4} М. Кинетин сохранил пигменты до 7-ого дня опыта. Уровень пигментов не восстанавливался под действием кинетина в контроле. Вероятно, поэтому, что новый синтез пигментов не имел места, а лишь стабилизировался уровень пигментов. В этиолированных листьях, поставленных на свет, разложение пигментов произошло сравнительно быстрее после 3—5—8-и часовой обработки водопроводной водой. Кинетин только приостановил процесс распада пигмента.

ИЗУЧЕНИЕ СОРТОВОЙ КОЛЛЕКЦИИ ЛЮЦЕРНЫ

А. ЯНОШИ, И. ШУЙОК

Задача венгерских селекционеров люцерны состоит в выведении ранних, зимостойких и устойчивых сортов быстрых темпов развития. Быстрые темпы начального развития и отрастания являются важнейшими особенностями интенсивных сортов, требующих высокого агрофона.

На центральной базе Агроботанического Института в Тапиоселе за период 1958—63 гг. было собрано всего 357 сортов. Из этого числа 176 были местные венгерские сорта, а остальные были получены из-за границы в порядке обмена.

Коллекция изучалась в период от 1958 до 1965 года в микроделяночном (6 м²) опыте без повторности по методу стандартного блока. Коллекция высевалась в четыре последующих года. Данные опытов свидетельствуют о том, что можно подобрать группы таких типов, которые в качестве партнёров для скрещивания могут с вероятностью успеха использоваться для получения сортов, соответствующих вышеописанным требованиям.

В статье приводятся лишь некоторые из числа многочисленных данных, характеризующих рекомендованные в качестве исходного материала сорта.

ПЕРСПЕКТИВЫ КАРЛИКОВОЙ ГИБРИДНОЙ КУКУРУЗЫ В ВЕНГРИИ

Л. ПАРАДИ

Селекция карликовой гибридной кукурузы по всем мире считается одним из возможных способов повышения эффективности производства кукурузы. Результаты наших опытов подтверждают правильность таких мнений.

Прибавки урожая в лучших гибридных комбинациях у нас составляют 11—26%. Эти предварительные данные требуют дальнейшего уточнения, но предварительные сведения уже достойны внимания.

ВРЕМЯ УБОРКИ И УРОЖАЙ КЕНАФА (HIBISCUS CANNABINUS L.)

Ф. Т. ОРАБИ

Обычно поздняя уборка увеличивала урожай зеленой массы на акр. Продукция волокна имела тенденцию увеличиваться в период от открытия первых цветков до созревания.

ВЛИЯНИЕ ЭЛЕКТРИЧЕСКОГО ПОЛЯ НА АКТИВНОСТЬ КАТАЛАЗЫ В ПОСЕВНОМ МАТЕРИАЛЕ

Й. П. МИХАЙФИ, Л. ШЕРФ

В статье рассматривается влияние гомогенного и негомогенного электрического поля статического характера на семена кукурузы, гороха и огурца. В отношении кукурузы и гороха эффект был неоднозначным, так как тенденции влияния изменялись и в зависимости от времени прохождения семян через поле. Активность каталазы в семенах огурца увеличивалась во всех вариантах обработки.

КОМПЛЕКСНЫЙ КАЧЕСТВЕННЫЙ ПОКАЗАТЕЛЬ ПШЕНИЦЫ

Ж. ПОЛЛХАМЕР

Для полной характеристики качества озимых пшениц была использована планиметрированная площадь под кривой, выведенной на основе 10 частных цифровых показателей. Полученный таким путем комплексный показатель одной цифрой характеризует полное качество сортов.

ОНТОГЕНЕТИЧЕСКОЕ ИЗУЧЕНИЕ РОСТА И РАЗВИТИЯ РАЙГРАСА (LOLIUM MULTIFLORUM VAR. WESTERWOLDICUM LAM.) В ЗАВИСИМОСТИ ОТ СКАШИВАНИЯ В ЧИСТОЙ КУЛЬТУРЕ В ПОЛЕВЫХ УСЛОВИЯХ

АЛИ РААФАТ, А. А. ЭЛЬ-МОРСИ, С. Х. ЭЛЬ-ГХАИАТИ

Нескошенные растения достигли их максимального роста, когда соцветия начали выпадать из их влагалищ и скорость накопления сухого вещества в период их плантации была низкой. Сухой вес листьев и стеблей сильно уменьшался скашиванием, а сухой вес стерни после скашивания снижался внезапно. Общие показатели сухого веса растения после скашивания составили примерно 1/6 часть максимального показателя нескошенного растения.

Общая продуктивность сухого веса листьев скошенных растений превзошла по производству сухого вещества листья нескошенных растений, противоположное этому явление наблюдалось в стеблях. Использование скашивания райграса обычно снижало общую продуктивность целого растения, когда сравнение проводилось с накоплением сухого вещества нескошенного растения.

НОВОЕ ПОВРЕЖДЕНИЕ КУКУРУЗЫ ШВЕДСКОЙ МУХОЙ (OSCINELLA FRIT L И СТЕБЛЕВОЙ МУХОЙ (ELACHIPTERA CORNUTA FALL.)

Б. ДОЛИНКА, А. ДЕЛИ

На кукурузе было замечено ранее не известное повреждение, гниль стебля, вызванная шведской и стеблевой мухами.

Наблюдения свидетельствуют о том, что стеблевая муха является только вторичным вредителем кукурузы, она повреждает только уже пораненные растения. Эффективный вред, причинённый при заражении в среднем 15% растений, хозяйственно незначительный. Стоит, однако, обратить внимание на вторичное повреждение мухой ***E. cornuta*** **Fall.** линий и гибридов, чувствительных к шведской мухе.

СРАВНИТЕЛЬНОЕ ИСПЫТАНИЕ МЕТОДОВ, ОПРЕДЕЛЯЮЩИХ АКТИВНОСТЬ ЭНЗИМА КАТАЛАЗЫ

Й. САЛАИ

В течение вегетационного периода в листьях яблони определялась активность энзима каталазы манометрически с помощью прибора **Scheibler'a**, газометрическим методом **Frenyó** и перманганатным титрованием. Все исследованные нами три метода пригодны для измерения изменения активности каталазы и могут служить для получения данных, связанных с онтогенетическим развитием и обменом веществ. Для полевых измерений рекомендуем газометрический метод Frenyó, т. к. он прост, и с точки зрения прохождения реакции точнее, чем два другие метода. Объем кислорода, освобождающегося в течение реакции при постепенном распаде пероксида, можно измерить непосредственно, и в сравнительно небольших образцах можно измерить активность энзима. Другие два метода можно рекомендовать для лабораторного определения активности каталазы.

ДАННЫЕ ОТНОСИТЕЛЬНО АКТИВНОСТИ НЕКОТОРЫХ ЛУЧИСТЫХ ГРИБОВ И МИКРОСКОПИЧЕСКИХ ГРИБОВ В РАЗЛОЖЕНИИ ПЕРЕГНОЯ

СЕГИ Й.

Подопытные микроскопические грибы оказались не в состоянии использовать гумат натрия, введенного в питательный раствор без дополнительного источника угля, а 22 подопытных штаммов лучистых грибов удовлетворительно росли в таких условиях и разложили значительные количества гумата натрия. В наличии дополнительных источников углерода (глюкоза, целлюлоза) значительная часть микроскопических грибов сможет разлагать гумат натрия, но существенно увеличивается и количество перегноя, разложенного лучистыми грибами. Совместное применение дополнительных источников углерода и азота только у части лучистых грибов способствует минерализации гумата натрия, а грибки при этом сокращают свою разлагающую активность. На основе изложенных фактов предполагается, что основная часть микроорганизмов — прежде всего микроскопические грибы — способна напасть на азотосодержащие боковые цепи перегнойных веществ, если среда содержит легко доступные источники углерода.

ВКЛАД В АУТЭКОЛОГИЮ ACHILLEA FRAGRANTISSIMA (FORSK.) SCH., BIP. С ССЫЛКОЙ НА СОДЕРЖАНИЕ В НЕМ МАСЛА

А. Ф. ШАЛАБИ, М. М. ЮССЕФ

Условия среды, включая климатические условия и почвы, поддерживающие *A. fragrantissima* в трех различных местностях засушливых египетских пустынь, были проанализированы и изучены. **Wadi Rishrash** наиболее благоприятное место для *A. fragrantissima*, что показано его превосходством и высоким содержанием эфирного масла в данной местности. Авторами изучалось действие осадков и глубины заделки семян на прорастание. Были определены также коэффициент размножения, амплитуда колебания осмотического давления пасоки, размер и вес семян.

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DIFFERENTIATION OF CELL WALL ULTRASTRUCTURE IN THE HAIRS OF CUCURBITA PEPO L.

By

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The cells of the hairs in *Cucurbita pepo* L. and the wall parts of same respectively, can — due to the relatively big size of the cells — be well dissected for the purpose of microscopic examinations. The polarization microscopic examinations of wall parts being cleaned and of a known position, have shown that the side wall of the lowest, so-called basic cell of the hair is mostly negatively birefringent, thus microfibrils get arranged in it in transversal direction. On the other hand, the birefringency in the side wall of the other cells has proved to be of positive character. In these latter cells it could be established that fibrillation was in fact of slanting direction which, in certain lamellae, showed varying directions thus bringing about intersected structure. Between transversal nicols there could be observed fibrils which might be considered fascicules of cellulose microfibrils. By way of these fibrils has become visible the intersected structure. The divergency showing itself between the wall structure of the basic cell and the other cells, can be explained by the fact that the basic cell grows rather in width while the other ones grow mainly in their length. The forces occurring on the occasion of growth in width, essentially maintain the original microfibril orientation. In the case of longitudinal growth, however, the microfibrils get shifted from their original position and approach, in their direction, the longitudinal axis. The transversal walls of the cells forming the hair, contain large pits the development of which is connected with the intensive plasmatic correlation between the cells.

Introduction

The fine structure of plant cell walls is determined essentially by the arrangement of cellulose microfibrils which form the skeleton substance of the cell wall. In the case of unidirectional arrangement of the microfibrils — which comes about in the majority of cell types — the cell wall becomes optically anisotropic and shows conspicuous birefringency. The birefringency of the cell wall with settled structure might mainly be attributed to the fact that within the cellulose microfibrils, too, — at molecular level — there exists a similarly settled and even crystalline structure (FREY-WYSSLING 1953, 1955, MÜHLETHALER 1960). The analysis of birefringency in polarization microscope renders it possible to determine the regularity and the sloping direction of the microfibrils i.e. to discern the most characteristic ultrastructural property (FREY-WYSSLING 1930, 1959). The fine structure of the cell wall is in striking correlation with the form, the growth processes and function of the cell in question. Thus, e.g. the wall of the conducting elements is fibrillated in transversal or slanting direction, that of the fibres in longitudinal direction, while in the paren-

chyma cells of the assimilating and storing tissues no such uniform orientation can be found (MÜHLETHALER 1950, ROELOFSEN 1959, GREEN 1960). In conformity with the varied development of the hairs, in the wall structure of the cells that form them, characteristic and heterogeneous traits may just as well be observed (FREYTAG 1955, 1957, UPHOF 1962). Our investigations refer to such multicellular hairs that reveal divergent characters in the growth of the individual cells and that phenomenon appears also in the structure of the developed cell walls.

Material and Method

Our examinations have been performed with the multicellular hairs found on the leaf of *Cucurbita pepo* L. — From the removed hairs — under stereobinocular dissecting microscope — cell wall particles have been dissected in a manner that during the later microscopic examination the proper place and the original orientation of the wall particles in question could be identified. The parts of the cell wall were purified in triethanolamine for 6 hours at 90°. Thus the non-cellulose substances have been removed from the cell wall and the optical peculiarities of the cellulose skeleton could be studied. In order to observe dichroism some cell wall pieces have been stained with a 1% solution of Congo red. The examinations have been made in Jena Zeiss-manufactured "Polmi A" polarization microscope as well as in phase contrast microscope.

Results

The cover hairs of *Cucurbita pepo* L. are — as it is well known — multicellular and are placed on a protuberant emergence (Fig. 1). The lowest, broad, so-called basic cell with the form of a truncated cone is followed by some other cells though being elongated but having also the form of a truncated cone. These upper cells generally differ from the basic cell in that their length (going upwards at a more and more increased rate) considerably surpasses their width. With the basic cell the situation is just the contrary. It is the transversal growth that dominates in them. With other cells the same can be said about the longitudinal growth. It goes without saying that the aforesaid characters of growth apply to the side walls of cells. The structure of the transversal diaphragms is much more characterized by the fact that through these walls intensive plasmatic connection develops between the neighbouring cells. Accordingly, the structure of the side wall and that of the cross wall has to be discussed separately.

The side wall of the basic cell observed in polarization microscope, between crossed nocils and inserting a compensator Red I plate has proved to be of negative birefringency. From this we might conclude that cellulose microfibrils run in transversal direction, i.e. cyclically in it. Through appropriate orientating of the dissection — performed between crossed nicols — the transversal fibrillatedness can be made visible (Fig. 2). The fibrils thus becoming visible might be considered fasciculi that consist of cellulose microfibrils and

are so thick that they can be seen even in light microscope. The rather uniform and transversal grouping of fibrils and microfibrils can be explained by the fact that the basic cell grows mainly in width. Thus there are no power impulses shifting the direction of the transversally organized fibrils. Examinations performed in *Nitella* cells and on other objects have indicated that in the tubular cells a transversal orientation is primordially developed, which — depending on

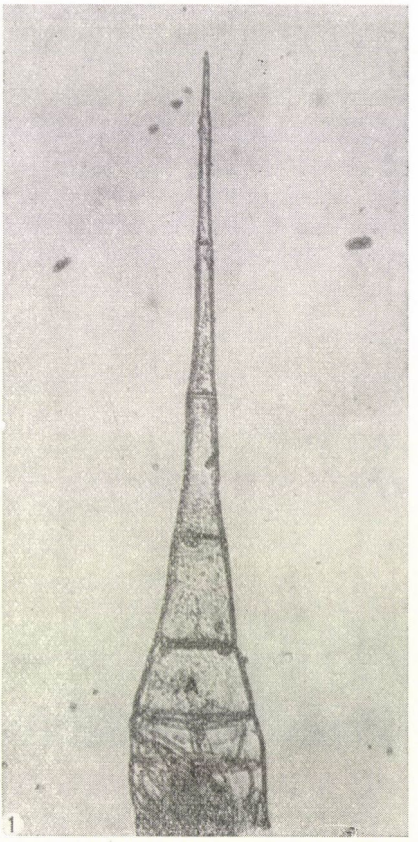

Fig. 1. Part of the cover hair, from the leaf-stalk of Cucurbita pepo L. Underneath the basic cell (A) there is a multicellular emergence (E). Approx. 50×

the direction and rate of later growth, — might get re-organized (GREEN 1960, 1963).

On the other hand, the cells attached to the basic cell and the following ones are positively birefringent; this, in general, indicates longitudinal structure. However, observations performed between crossed nicols in several kinds of polarization have shown that fibrils are of slanting character and then microfibril orientation — considering the whole side wall, — is helicoid. The

direction of these spiral lines, however, is contrasting in the cell wall lamellae, therefore, we actually have to deal with intersected structures (Fig. 3). Towards the top of the hair the direction of fibrillization forms a continually smaller angle with the longitudinal axis of the cell. The above-mentioned positive birefringency is produced by the general effect of the intersected microfibril orientation. The formation of the above-outlined wall structure might be explained in the way (ROELOFSEN 1959, GREEN 1960) that the power impulses

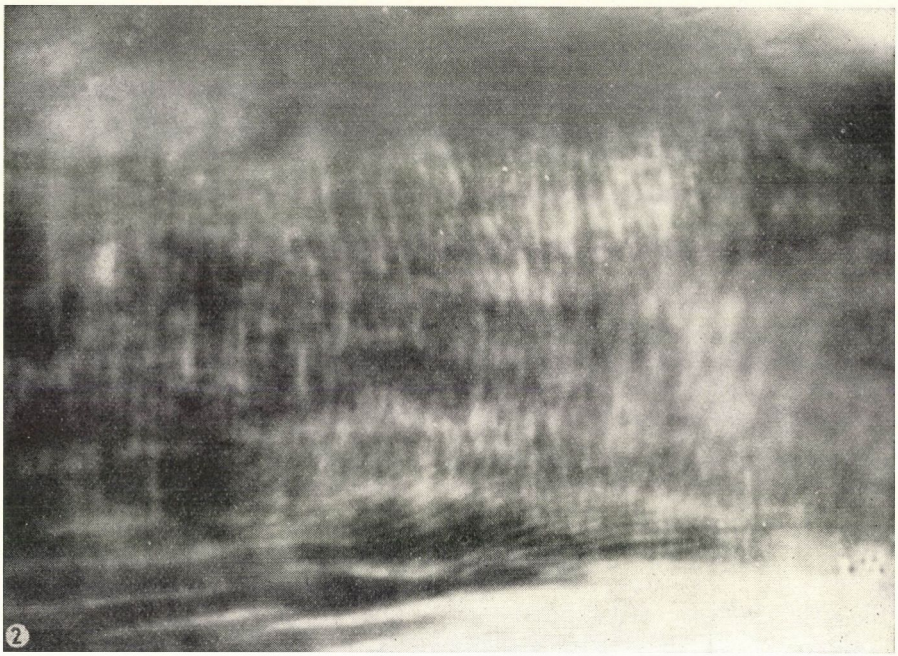

Fig. 2. Transversally fibrillated wall-part from the side wall of the basic cell between intersected nicols. Approx. 1200 ×

occurring on the intensive longitudinal growth, shift the microfibrils from their original position and so much the more the longer the longitudinal growth lasts. From this it follows that mainly the mikrofibril orientation of the oldest i.e. the most external cell wall lamellae gets re-organized.

A peculiarly organized structure develops on the meeting spot of the side and cross wall. Between intersected nicols thicker microfibril fasciculi fibrils being settled rather paralelly can be observed (Fig. 4). These thick fibrils are supposed to strengthen — at the fitting — the connection of the side cross wall.

Since the cells have always the form of a regular truncated cone the cross walls are circular and thus, there is no distinguished direction in their growth. The most characteristic of their microscopic structure is that numerous, rela-

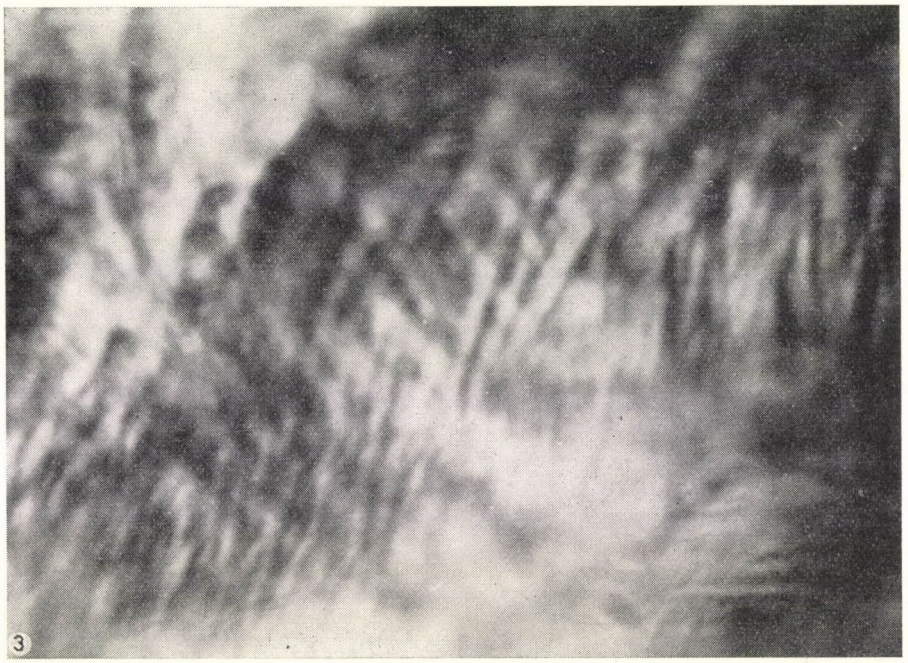

Fig. 3. Intersectedly fibrillated wall-part from the side wall of the second cell above the basic cell, between crossed nicols. Approx. 3500 ×

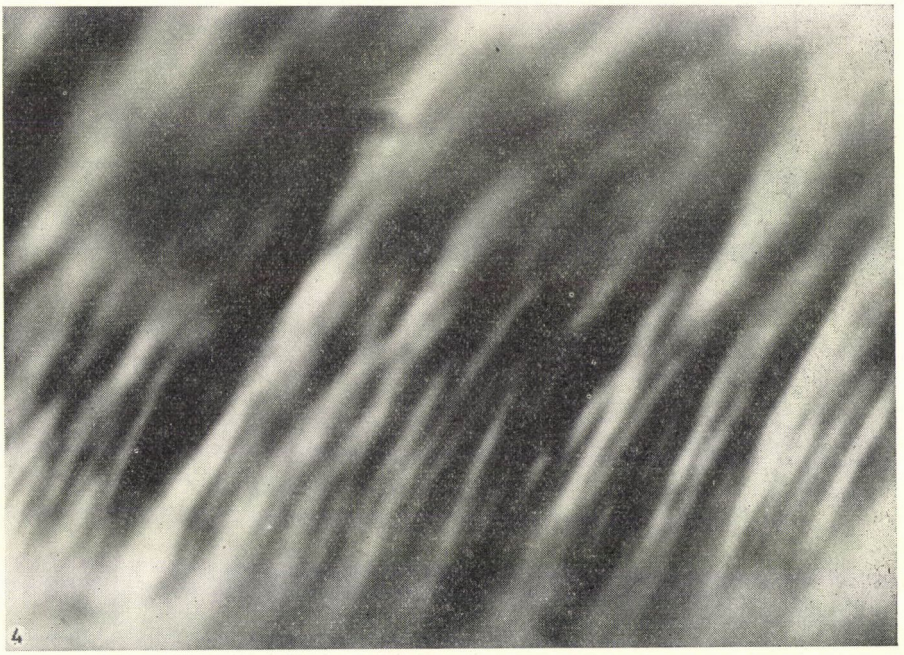

Fig. 4. Parallelly arranged fibrils at the fitting of the side and cross wall, between crossed nicols. Approx. 3500 ×

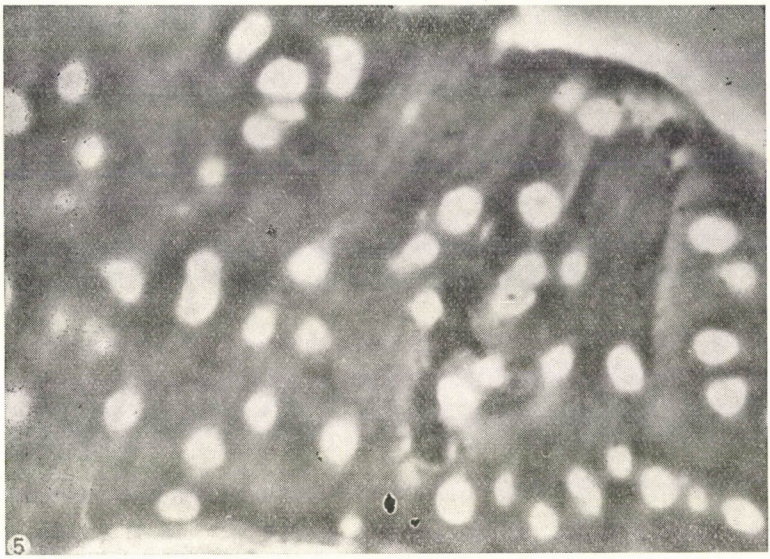

Fig. 5. Section from the upper transversal and pits containing wall basic of the basic cell. Phase contrast microscopic picture. Approx. 800×

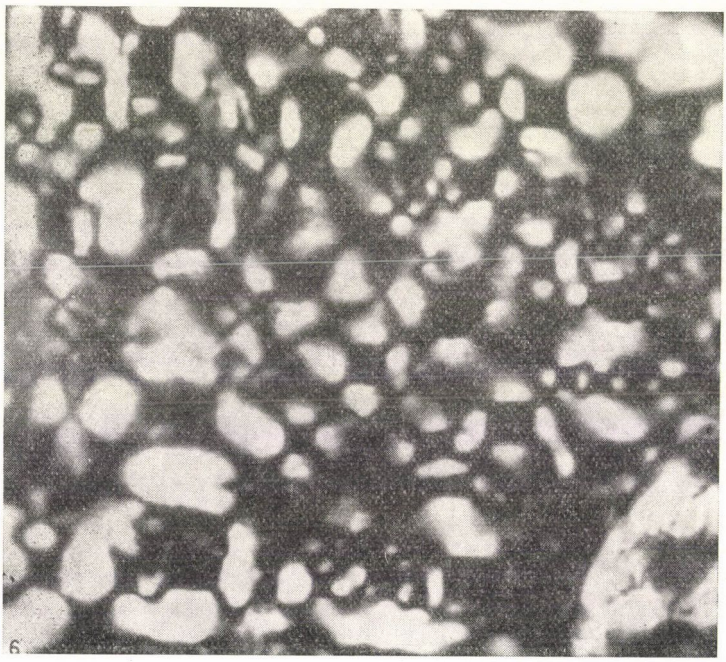

Fig. 6. Section from the upper transversal wall of the basic cell, between crossed nicols. Approx. 800×

tively large (with a diameter of 4—8 mikrons), partly circular and partly irregular pits are visible on them which are especially conspicuous in phase contrast microscope (Fig. 5). In polarization microscope, between intersected nicols it can be well seen that around the pits there exists an oriented structure (Fig. 6). By inserting Red I compensator plate, it can be detected that the microfibrils take place circularly around the pores. It is conspicuous that the circularly settled belts around the pits are rather broad, thus relatively

Fig. 7. Section from the lower transversal wall of the basic cell, with oval pits, between crossed nicols. Approx. 1800×

little area is on the cross wall in which microfibrils are situated in disorder. The lower cross wall of the basic cell is in touch with not one but several cells belonging to the emergence and accordingly, the same number of parts gets separated on it. In the growth of the emergence cells there exists already a certain control which is also revealed in the structure of the contacting wall of the basic cell. In this respect the most conspicuous are the oval forms of the pits and the parallel arrangement of their longitudinal axes (Fig. 7).

Conclusions

The observations and results described above, confirm the notion according to which the growth tendency of the cell exerts influence on the formation of the wall structure of the cell in question. In the case of transversal growth there remains the original microfibril orientation, while the longitudinal growth results in the direction of microfibrils approaching more or less the direction of the longitudinal axis of the cell. In this connection we want to point out that in the case of the hair examined, cells being of common origin, similar construction and function are concerned. In fact they differ only in the proportion of cell-length and cell-width, which, on the other hand, can be attributed to the difference of their growing tendency. Therefore, we may well suppose that the difference established in the fine structure of the tubular side wall — especially between the basic cell and the other ones — is due to the discrepancy of growth trends.

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STUDIES ON THE GROWTH OF JERSEY CALVES FED ON MILK AND MILK REPLACERS

By

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The present study offers a method for raising young Jersey calves and developing the rumen function at an early age. This was accomplished by the introduction of dry food in the diet from the fourth week, when rumen function started to develop, instead of feeding them wholey on milk. The diet given was rich in protein and contained necessary minerals with small amounts of cellulose, since dry roughage is usually rejected. Tender freshly cut green fodder as young clover (barseem) or nicely cut green darawa (green maize) was also given. Water was available for calves ad libitum and the youngs were tied to their mothers to have a great chance for ingesting dropped food from mother's mouth during rumination.

Gradual feeding dry food besides milk and green food, to young Jersey calves, though it increased the growth measure and starch value consumed consequently, yet, it enhanced growth rate and spared 18 per cent of the price of kg. body weight.

As compared to local breed cows and buffaloes, Jersey calves of the present study exhibited a lower growth measure and higher daily gain.

Introduction

For some decades now it has been the practice in raising and fattening calves to replace whole milk by other less expensive feeding stuffs (ADAMS *et al.* 1959, SOLIMAN—SOLIMAN 1965). The reason for this procedure is that the substitution of other suitable and cheaper feeding stuffs permits substantial economies to be effected in the cost of feeding calves. Apart from this distinct economic advantage there are also others based on considerations of health. For example, the use of suitably compounded milk replacers (with minerals, vitamins besides plant food stuffs) precludes the danger of calves being infected with tuberculosis through their feed and minimizes the mortality among suckling calves during a period of three months (COMBERG—GOLLNITZ 1958, DROULISCOS—VERBEEK 1960, NAJMAN—HLADIK 1962, SRAMEK 1962, ODONOVAN 1963).

BACVANSKI *et al.* (1963) concluded that reducing the amount and duration of milk feeding led to a drop in daily weight gain. The carcass quality of the animals brought up by this way, however, is not reduced (GREEN—BURIC 1953). Therefore, further investigation should be carried out to find out the suitable amounts of milk and milk replacers necessary for early weaning calves.

The present investigation endeavours to study the question to what extent the "suckling status" during the early life of the calf can be modified by nutritional measures. The main object of such a procedure is based upon rendering the digestive apparatus and capacity of the calf, which is at first still very limited and restricted to utilize milk-like products, capable of accepting and utilizing cheaper feeding stuffs such as coarse-ground cereals and hay at as early a time as possible. It is planned also to fetch a suitable and economical ration for satisfactory growth of Jersey calves during the suckling period.

Material and Methods

For this study eighteen newly born Jersey calves were selected from the Farm of Faculty of Agriculture-Assiut, U. A. R. The mothers of these calves were proved to be *Brucella* and *Tuberculosis* tests negative. The animals were divided into two groups. Group I included six calves which were kept as controls and given colostrum in the first week ad libitum and then fed on milk according to the following scheme. From the eighth to twenty-one days the calves were given three kg. whole milk, from twenty-two to ninty-one days given four kg. whole milk and from ninty-two to one hundred and twenty-six days given two kg. whole milk daily per head. The colostrum and milk were hand-fed to calves individually using the milk nipple pails as calves take milk more slowly and hence have no digestive upsets.Milk was given twice daily shortly after milking in equal parts, at 8.00 a. m. and 5.00 p. m. From the beginning of the fourth week calves received one kg. clover *(Trifolium Alexandrinum)* or darawa (green maize), daily per head, till weaning.

Group II comprised twelve newly born Jersey calves which were treated in the same manner as those of the first group. In addition, each calf was given, from the beginning of fourth week to the end of the thirteenth week daily half kg. of a dry mixture composed of 50 per cent maize, 25 per cent decorticated cotton seed cake and 25 per cent bran (having a starch value of 70 per cent) and from the fourteenth week to the eighteenth week one kg. dry food. The animals were tied to the neck or front legs of their mothers. Water was offered to calves ad libitum as it is essential for rumen digestion and to attain a fluid texture so that chemical, bacterial and enzymatic digestion might take place.

Each animal was weighed directly after birth, and at seven days intervals till the eighteenth week at 8.00 a. m. before feeding. The average weight, standard error was calculated for each group at every experimental interval. The maximum gain per period, weekly and daily gain were calculated for both groups. The growth measure was calculated from the starch value necessary for producing one kg. live weight. Results were analysed statistically using the "t" test in order to evaluate the differences obtained between both groups.

Results

The daily gain in the whole period was 0.54 and 0.66 kg. (Table 2) and the weaning weight became 87.33 and 106.08 in group I and II, respectively (Table 1). These findings indicate that weaning weight was 4.44 and 4.69 times their birth weight in control and treated calves. The total gain during the whole period was 67.67 and 83.50 kg. in group I and II i.e. was higher in the latter rather than the former (23 per cent).

The maximum average daily gain in both groups during the whole periods was more evident at the fourth period, reaching 0.76 and 0.79 kg. for group I and II, respectively. The birth weight was doubled at the end of the seventh week (2.04 and 2.05 times for control and treated calves).

Table 1

Average body weight, weekly and daily gain of Jersey calves (kg) fed on milk and those given milk and dry food

Age (week)	Group I (control)			Group II (treated)		
	Absolute wt.	weekly gain	daily gain	Absolute wt.	weekly gain	daily gain
At birth	19.66 ± 0.90	0.00	0.00	22.58 ± 0.92	0.00	0.00
1.	22.16 ± 1.42	3.50	0.50	24.16 ± 0.91	1.58	0.23
2.	27.00 ± 1.08	3.84	0.55	26.83 ± 1.06	2.67	0.38
3.	30.16 ± 1.02	3.16	0.45	30.16 ± 1.20	3.33	0.47
4.	31.16 ± 0.92	1.00	0.14	33.41 ± 1.31	3.25	0.46
5.	33.66 ± 1.00	2.50	0.36	37.00 ± 1.42	3.59	0.51
6.	35.83 ± 0.69	2.17	0.31	42.16 ± 1.61*	5.16	0.74
7.	40.16 ± 0.93	4.33	0.62	46.33 ± 1.64*	4.17	0.58
8.	43.33 ± 1.35	3.17	0.45	51.08 ± 1.99*	4.75	0.68
9.	46.33 ± 1.08	3.00	0.43	57.00 ± 1.77*	5.92	0.85
10.	49.33 ± 0.99	3.00	0.43	61.25 ± 2.01*	4.25	0.61
11.	53.16 ± 1.33	3.83	0.55	66.58 ± 2.30*	5.33	0.76
12.	57.00 ± 1.36	3.84	0.55	72.17 ± 2.52*	5.59	0.79
13.	60.66 ± 1.62	3.66	0.52	78.33 ± 2.73*	6.16	0.87
14.	64.66 ± 1.95	4.00	0.57	84.66 ± 3.72*	6.32	0.90
15.	70.16 ± 3.34	5·50	0.79	90.50 ± 3.11*	5.84	0.83
16.	76.50 ± 3.17	6.34	0.91	94.83 ± 3.01*	4.33	0.62
17.	82.66 ± 3.28	6.16	0.87	100.33 ± 2.96*	5.50	0.79
18.	87.33 ± 3.35	4.67	0.67	106.08 ± 3.08*	5.75	0.82

± Standard error.
* Statistically higher than control values of the same age at 0.01 level of probability.

Table 2

Comparison between the body gain, per week and day (kg), in calves in relation to the food consumed

Duration (days)	Food consumed (kg.)				Total gain (kg.)		Daily gain (kg.)	
	milk group I & II	green group I & II	dry food		control I	treated II	control I	treated II
			control I	treated II				
1—7	colostrum	0.00	0.00	0.00	3.50	1.58	0.50	0.22
8—21	42.00	0.00	0.00	0.00	7.00	6.00	0.50	0.43
22—91	280.00	70.00	0.00	35.00	30.50	48.17	0.44	0.69
92—126	70.00	35.00	0.00	35.00	26.67	27.75	0.76	0.79
1—126 (total)	392.00	105.00	0.00	70.00	67.67	83.50	0.54	0.66

Table 3

Starch value, growth measure and price of food consumed in the whole period of both groups

		Group I (control)	Group II (treated)
Starch value	1. Milk*	79.58	79.58
	2. Supplement	0.00	50.00
	3. Total	79.58	129.58
Growth measure		1.24	1.57
Price of food			
(pound)	1. Milk	31.36	31.36
	2. Supplement	0.00	1.75
	3. Total	31.36	33.11
Price of kg. body weight		48.49	40.41**

* Starch value/kg = 0.2 and price of kg = 0.08 pound (8 piastre).
** Difference = 8.08 piastre i. e. 19.19% less than control price.

The growth measure in group I and II, during the whole period was 1.24 and 1.57, respectively. However, the gain in body weight overcomes such a rise in starch value of food consumed (Table 3).

Discussion

In the present study, colostrum has been given to both groups of calves ad libitum, as it provides passive immunization against various infectious diseases of the young calf (lactglobulin) as well as factors essential for their survival and development. By gradually giving dry food together with milk and green food, after the fourth week there was a decided rise in their body gain and an upward trend rather than with control calves (Fig. 1). The food material offered to calves during the early life contained very small amounts of fibrous material. Usually cellulose is the substance which encapsulate the nutritive materials present in the food of plant origin. It must be borne in mind that large amounts of fibrous material when offered to calves cause maladaptation and excessive harmful fermentation.

The available data indicate that it is preferable to stop milk feeding completely by the seventh week (WILLIAM—KNODT 1950, BRUMBOUGH—KNODT 1952, POUNDEN—HIBBS 1953, STEIN *et al.* 1954, HOGUE *et al.* 1956, HOLLON *et al.* 1958). Several other investigators weaned calves after 25—45 days and reared them on 25—77 kg. milk and then fed on dry food (CASTLE—NISTON 1959, FERNANDEZ 1959, DROULISCOS—VERBEEK 1960, NAJMAN—

HLADIK 1962, PARDUE *et al.* 1962, BACVANSKI *et al.* 1963, BRUNDAGE—SWEETMAN 1963, HLADIK—NAJMAN 1963, ODONOVAN 1963, ABDEL-MALIK 1964, KHOURY 1964). MAGLIANO (1958), however, did not advise early weaning for the difficulty of making mixtures having the same amino acids as milk and MERGALLI (1953) advised that milk should be offered at least up to the sixty to seventy-three days.

The average daily gain during the early life of Jersey calves studied (18 weeks) was 0.54 kg. in control calves and 0.66 kg. in those fed the dry ration besides milk and green food. The body weight was doubled, in both groups, at the seventh week. GHONEIM *et al.* (1956, 1957) reported an average daily gain

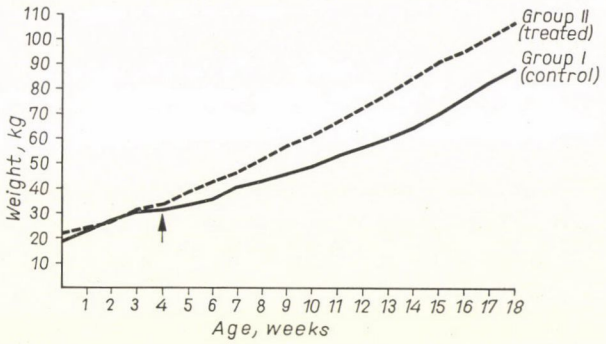

Fig. 1. Growth of Jersey calves from birth till weaning

in native breed calves of 0.52 kg. and the weight was doubled at the end of the eighth week. Similar findings were obtained in foreign breeds (LUSSE 1954, ESKEDAL *et al.* 1956, VILLINGER 1956, MCNEIL 1957, NATESOVA 1957). Several investigators recommended to rear calves on amounts of whole and/or skimmed milk having the same nutritional value of food given in this study and obtained rather the same ranges of daily gain (LEISNER 1957—58, SIMONJAN 1957, GOCITASVILI 1958, HOFFMAN—GÜTHER 1958—59, MÄKELA 1958, HOMB 1960, JEROCH *et al.* 1961—62, ADAM *et al.* 1962, BERKE—BEDO 1963, CZAKO 1962, CZAKO *et al.* 1963, BUTKEVICENE—VAGONIS 1963, SALEM 1965). From the present study it is evident also that there is a significant correlation between the weight gain and concentrate consumption (Table 3) lending support to the findings of WHITAKER *et al.* (1957) in Friesian and Jersey calves.

Some investigators fed calves rather higher amounts of milk before weaning (200—300 kg. whole milk and 600—800 skimmed milk) till weaning (CZAKÓ 1958, 1962, MÄKELA 1958, 1959, RAGAB—ABDEL AZIZ 1961, BERKE—BEDO 1962, 1963, BUYSSE—MARTIN 1962, CALOTOUI *et al.* 1962, MATHIEU—MEGAT-LITRE 1962, MYSJUTKINA 1963, VAN MARLE 1963). Others, however, claimed to reduce and save milk at first by restricting weight gains of calves

to 400—500 g. daily (RICHTER 1957, 1958, 1959, ENGELHARDT—THIELE 1962, KORIATH *et al.* 1962, LUKSLINJA 1962, BEGUCEV 1963). JOTTRAND (1957) reported that it is most profitable to rear heifer calves on 100—150 litres milk and 200—250 litres skimmed milk with 75—80 kg. concentrate.

Furthermore, it has been found that calves do not need more than 150 kg. whole milk with 65 kg. dried skimmed milk supplemented with vitamins (KIRSCH *et al.* 1957). BOBEK—MOLNER (1959) found no significant differences in weight gains between calves fed on 35—400 litres and 2 per cent fat milk and 550—650 litres skimmed milk. By reducing the amount of consumed milk, the production costs were therefore lower (LEISNER 1957, 1958, NOLLER *et al.* 1957, KLIESCH—HORST 1959, MEREGALLI 1959). The present study indicates that, although the starch value is higher in treated calves yet the production costs are reduced by 20 per cent (Table 3).

It has been thought previously that the function of the rumen starts only after three months of age, however, it has recently been proved that rumen function starts at an earlier time by the introduction of solid food (KON—PORTER 1954, MAZIERE 1956, SOLIMAN—SOLIMAN 1965). Whereas the rumen and reticulum enlarge only to a limited extent during milk-feeding, feeding hay or coarse ground cereals from the third or fourth week results in an unmistakable development and functioning of the rumen (POUNDEN—HIBBS 1948, 1950, HIBBS—POUNDEN 1949, JACOBSON *et al.* 1951, CONRAD—HIBBS 1950, 1953, 1957, HIBBS *et al.* 1953, BROWNLEE 1956, WARNER 1956, HIBBS—CONRAD 1956, 1958).

From the present work it appears that calves feel the need for the gradual consumption of solid elements as it is the main actual physiological stimulant factor to the function of the rumen since the development of rumen volume lost its function. The rumen micro-organisms are introduced earlier into the alimentary tract together with the diet which contains bacteria and protozoa on their surfaces and become acclimatized therein before starting their function.

Table 4

Daily gain and growth measure of Jersey calves (present values), as compared to values of Friesian and local breed calves and buffaloes (values given by SALEM, 1965)

	Daily gain (kg.)	Growth measure
Buffalo calves	0.329	2.115
Cow calves (local breed)	0.383	1.800
Cow calves (Friesian)	0.701	1.814
Cow calves (Jersey) 1. Control	0.540	1.240
2. Treated	0.660	1.570

Jersey calves have shown higher daily gain and lower growth measure than buffaloes and local breed calves and even lower growth measure values than Friesian calves (SALEM 1965) though the daily gain in the latter is markedly higher (Table 4).

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BIOCHEMICAL PROCESSES OF VERNALIZATION

VI. THE CHANGE OF THE PHYTOCHROME CONTENT IN THE COURSE OF VERNALIZATION

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The appearance and the quantitative change of the phytochrome content have been studied in the course of vernalization of winter wheat *B 1201*. It has been established that the active phytochrome could not be evinced in unvernalized plants. The formation of the active phytochrome occurs in the second half of vernalization only. The process does not require light. Due to the effect of high temperature (30°C) the nonphotochemical transformation of the phytochrome can be observed, however, at a certain stage of vernalization only.

Introduction

When studying the action spectrum of flowering photocontrol, it was found that in the directing of plant development a pigment capable of reversible transformation, had an important role. The pigment called phytochrome, can be isolated as a water soluble protein and can be determined photometrically (LANE *et al.* 1963).

Between vernalization and photomorphogenesis there exists a very close interaction. The non-vernalized winter wheat is a short-long day plant (PURVIS 1961). Under the influence of cold induction exerted for several weeks the photoreaction gets changed into characteristically long-day type. As a result of cold-induction vernalization — the "photoreaction nature" of the plants gets changed (FRIEND 1965).

Such close interaction between the photoperiodic reaction ability and vernalization as well as the light effect observed for the stabilization of the cold induced state (GOTT—GREGORY—PURVIS 1955, FRIEND—PURVIS 1963) have suggested that the photomorphogenetic pigment, the phytochrome might be brought in some connection with the phenomenon of vernalization. The problem was studied in details by FRIEND (1965) on the *Petkus* winter rye. He established that the flower-induction promoting effect of the red and far-red radiation had not been able to be proved during cold induction as long as the seeds had not been completely vernalized. He drew the conclusion that the phytochrome system did not take part in the flower induction promoting effect but was capable of stabilizing, to a certain extent, the cold effect.

On the basis of the above the question has been raised when it was that the phytochrome appeared in active state, in the leaves of winter wheat and, as a consequence, when the plant was capable to take up the long-day photoperiodic stimulus. Experiments were set up to elucidate under what temperature and day-length the active phytochrome would appear in the leaves of the winter wheat *B 1201*.

General Methods

As experimental plant the winter wheat *B 1201* had been used at the stages of germinated seed and of seedling with two leaves.

The cold requirement in germinated seeds state the winter wheat *B 1201* used for our experiments, is 45—50 days (RAJKI 1960). The variety has been bred for 40 years, the breeding being based on careful individual selection (RÉDEI *et al.* 1953). When seeded late in spring (the middle of April) it either does not form ear at all (RAJKI 1960, MESCH 1965) or only late, in a very low percentage (RÉDEI *et al.* 1953). There is only one data available (POZSÁR 1966) according to which in late spring sowing the *B 1201* produces ear formation of 70-80 per cent and even of 100 per cent. These data are not supported by the results of other researchers. Our experimental material had been controlled throughout many years in winter and spring sowings. Depending on the year, in late spring seeding there was no ear formation at all or only late and scarce earing could be noticed. RAJKI (1960) obtained similar results on the basis of examina tions made with the same material.

Vernalization of the seeds was performed at a temperature of 0°C in refrigerator (DÉVAY 1962). The seeds having been vernalized for 0, 7, 14 , 21, 28, 35, 42 and 49 days, had been put into perlite and then, up to the age of 12 days, they were cultivated under conditions already described (DÉVAY 1962), 85.000 erg cm^{-2} sec^{-1} light intensity (= 10—12.000 lux) under long-day (16 hours) and short-day (8 hours) conditions at a temperature of 15°C in climatic chamber. Besides the plants of "light growth", etiolated plants having been kept at the same temperature, were also used.

The vernalization of young plants (with two leaves) was carried out at 0, + 2°C temperature applying the above mentioned light intensity and day length. The young seedlings had been kept, up to the age of having two leaves (until the beginning of cold induction), at 15°C in a short day.

The grade of vernalization was measured by the time of the appearance of flower primordia (16 hours of light, at a temperature of 17°C) in the case of vernalizing seedlings. When vernalizing had been carried out in germinated seed state, for establishing the grade of vernalization, the respective data of RAJKI (1960) were taken into consideration.

The determination of the phytochrome was made by way of the method of LANE *et al.* (1963) on Beckman B spectrophotometer. 3 g of wheat leaves were frozen and then pulverized with sand. The extracting of the phytochrome was performed with 50 ml 0.05 M sodium pyrophosphate containing 0.001 M EDTA solution at pH 7.4. The extraction was centrifuged at 4.000 g. The pure solution was saturated, under cooling, with ammonium sulphate up to 50% in a manner that during the precipitating the pH should remain 7.4. After 30 minutes the precipitate separated, was gathered by 4.000 g centrifuging lasting 15 minutes. The precipitate was dissolved in the solution of 10 ml 0.01 M sodium phosphate buffer + 0.001 M EDTA (pH 7.5). This fraction was again saturated with ammonium sulphate up to a level of 33%, at pH 7.5. Once the precipitate separated, centrifuging was performed and the precipitate was dissolved again in 5 ml of the previous buffer. At this point the pigments grew concentrated to such a high degree that actual determinations could be made. Further fractionating did not cause considerable phytochrome concentrationing. In our case ultracentrifuging as used by LANE *et al.* (1963), proved to be unnecessary.

In the extract the quantity of the phytochrome was determined with spectrophotometer, on the basis of optical density change after 5 min. far-red (730 mμ) and then 5 min. red (660 mμ) irradiation, the absorption difference was measured between 660 and 730 mμ. The total phytochrome quantity in the 5 ml was calculated according to the following formula: $P_{total} = \Delta OD_{660} - \Delta OD_{730}$ $\varepsilon = 2 \times 10^{-4}$ (BUTLER *et al.* 1963).

The values obtained were submitted, on the basis of the given molar extinction coefficient, referred to 1 g fresh weight, in 10^{-6} M order of magnitude. The gained data could be reproduced with an accuracy of $\pm$ 10 per cent. The processes of extraction and precipitation were performed at 2°C, while the activating irradiation and the measuring were made at a temperature of 18—20°C.

Results

Cold requirement of seedlings under long- and short-day conditions. The young *B 1201* plants having two leaves had been kept at 2°C temperature for 2, 7, 14, 21, 28, 35, 42 and 49 days under conditions described in the methods, then the appearance of flower primordia was examined at 16 hours of light and at a temperature of 17°C, every third day on 5—5 plants. After the formation of ear primordia the number of the examined plants was increased to 20. In

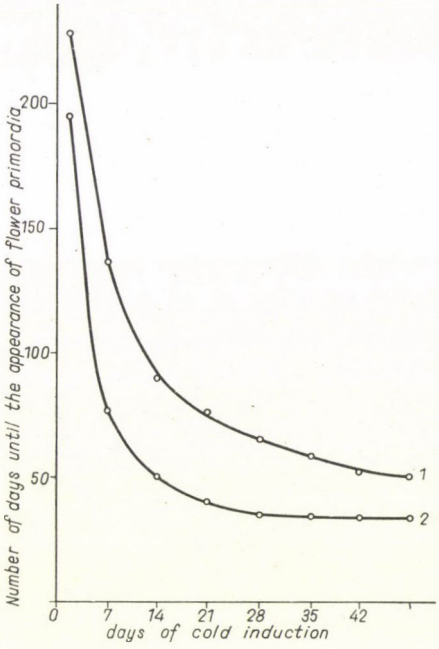

Fig. 1. Vernalization of B. 1201 in green plant stage. Flower induction promoting effect of low temperature (+ 2°C), (1) on long-day and (2) on short-day

this way we succeeded in establishing the time of the appearance of the flower primordia with an accuracy of three days. For determining the degree of vernalization — because of the long waiting time, — we have not availed ourselves of the method considering the final leaf number that is usually applied. Though it requires more work, the preparation of the shoot tip is one of the most accurate methods (NAPP-ZINN 1961). In the case of 0-day vernalization, the appearance of the flower primordia was so prolonged that we have found it better to apply, as a start, the two-day cold treatment. The results of the experiment are shown in Fig. 1.

Comparing the curves of the plants vernalized under short and long days, the vernalization inhibiting effect of the long day can be seen well. In the case of 8-hour day length at a temperature of 2°C, a further decrease of time needed

for the appearance of the flower primordia cannot be observed any more. In order to obtain similar vernalization level, 49 days were needed with 16-hour day length. The vernalization inhibiting effect of the long-day is well-known with several plants, among them wheat (RAZUMOV 1964); there are, however, such data too, according to which the day length has no effect on vernalization (NAPP-ZINN 1961). According to our unpublished data, the effect of day length is different with the wheat varieties. Therefore it was necessary to approach this question in the winter wheat *B 1201.*

Formation of the quantity of phytochrome with short- and long-day treatments in the leaves of young wheat plants. In the leaves of seedlings vernalized under 8 and 16 hour-day length conditions and at a temperature of 2°C, we determined the content of phytochrome every week from the beginning of vernalization, altogether on 8 occasions. The data are shown in the graph 2.

It can be observed that in non-vernalized plants with two leaves being pre-cultivated at a temperature of 15°C, the phytochrome cannot be proved in active state by the methods applied. Both with short- and long-day lengths a quick increase in the quantity of active phytochrome can be observed especially in the 14—28 days period of vernalization. After this the phytochrome level "sets in". The "phytochrome level" of the two variations is nearly the same.

Formation of the phytochrome quantity in seedlings with two leaves being vernalized in the state of germinated seeds. In order to distinguish the effect of light and cold induction regulating the phytochrome level, we have examined the phytochrome content of seedlings developed from seeds being vernalized to different extent, under long- and short-day length conditions and in dark. The data are summarized in Table 1.

Table 1

Changes of phytochrome content in seedlings, vernalized at germinized seed state (10^{-6} M/g fresh weight)

Vernalization, in days	on short day	on long day	etiolated plants
0	—	—	—
7	—	—	—
14	—	—	—
21	—	—	0.60
28	—	—	1.00
35	—	0.50	1.11
42	—	0.75	1.25
49	0.50	1.00	1.25
56	1.00	1.50	1.25

— = no phytochrome can be evinced.

From the etiolated plants being at different vernalization level, the active phytochrome can be well traced from the 21st day of vernalization (complete vernalization: 49 days). Under the effect of long-day only from the 35th day on, while with short day only after the entire (49 days) vernalization. Of non-vernalized plants neither here could be traced the active phytochrome.

According to data obtained with etiolated plants, the active phytochrome gets developed sooner in the course of cold induction than as observed with plants cultivated under long or short day.

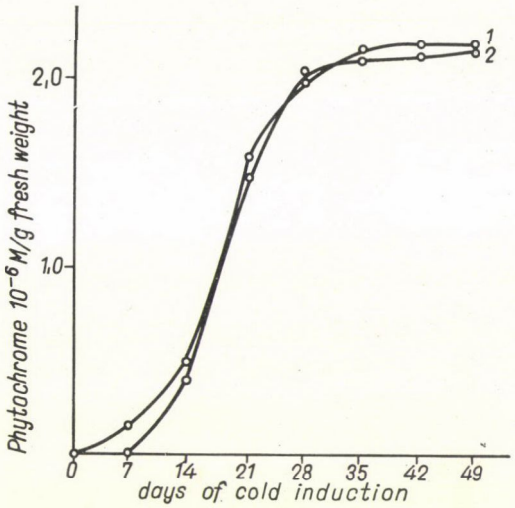

Fig. 2. The changes of phychrome content at long (1) and short (2) day. Vernalization at green plant stage

That phenomenon called the attention to the stability conditions of the developing phytochrome. It might be supposed that the phytochrome developing at certain stages of cold induction (on the 20—25th days) is not yet a stable form. The in vivo nonphotochemical transformation of phytochrome is well known with maize (BUTLER *et al.* 1963). For this reason has been studied the effect of high temperature (30°C) on the stability of the phytochrome.

Nonphotochemical transformation and stability conditions of the phytochrome at different rates of the vernalization. In order to decide the stability-grade of the phytochrome in the etiolated plants during vernalization, we have studied the effect of short-time devernalization on the content of the phytochrome. According to our previous experiments, a heat treatment of some hours (5) decomposes the bulk of the phytochrome. The result of the treatment on the phytochrome level is demonstrated through the data of Table 2.

The five-hour heat treatment at 30°C has entirely decomposed the phytochrome brought about as a result of 21—42 days vernalization occurring in germinated seeds; the one developing under the effect of 42 days vernaliza-

Table 2

Devernalization temperature stability of the phytochrome at different grades of vernalization (12-day old etiolated plants being vernalized in germinated seed state, 10^{-6} M phytochrome) (g fresh weight)

Vernalization, in days	Starting phytochrome content	Phytochrome content after 5-hour treatment at 30°C
21	0.60	—
28	1.00	—
35	1.11	—
42	1.25	0.50
49	1.25	1.50
56	1.25	1.25

— = no phytochrome can be evinced.

tion has been decomposed in 60 per cent while after entire vernalization no decomposition can be observed. These data refer to the change of structural stability of phytochrome brought about (or activated) under the effect of cold induction. It seems to be very interesting to elucidate what might be the difference between these two forms of phytochrome.

Conclusions

We have examined the appearance and quantitative change of phytochrome during the vernalization of winter wheat *B 1201*. It has been established that in unvernalized plants active phytochrome cannot be evinced by our method. The formation of active phytochrome occurs only in the second half of vernalization. That process is not light-requiring. This is proved by the fact that it can be evinced at certain degrees of vernalization also in plants developing in dark from germinated seeds being at different vernalization levels. The formation of active phytochrome must certainly be considered as an effect of cold induction, viz. the specific process of vernalization. A final phytochrome of stable form does not most probably develop directly, in only one step in the course of vernalization. It seems that first a less stable form might come to existence.

The negative data of FRIEND (1965) referring to the existence of the phytochrome system under the flower induction promoting effect, — of cold — can be well explained on the basis of the above. The inefficiency of red and far-red radiation might be explained by the lack of the phytochrome system. Under the effect of vernalization occurring in the state of germinated seed the

active and stable phytochrome and, together with that, most probably the whole long-day photoreceptor system develop as a result of cold induction. Thus, it would be obvious to suppose that the C material suggested by PURVIS (1961) was the phytochrome itself the development of which had been blocked at short day length and in unvernalized state which blocking was, however, released by cold induction. The system forming due to the development of the phytochrome then enables the plant to take up the long-day photoperiodic stimulus. This supposition is true partly only. The formation of the active phytochrome is one, however, not the only step of the flower induction effect of the low temperature. This is also proved by the vernalization inhibiting effect of the long-day treatment. Here the active phytochrome had developed and yet the course of vernalization was inhibited. It seems to be likely that during vernalization we have to reckon with several processes occurring parallel which are able to produce together only the flower inducing effect of low temperature. To elucidate this question further experiments will be needed.

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VEGETATIVE PROPAGATION OF THE WALNUT VARIETY FERTŐDI E. 1 BY WAY OF ROOTING

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The efficiency of the split-rooting method has been tested on walnut scions. Splitting proved to be efficient only in the case when in autumn scions, once their root being cut off on one side, were laid into a furrow of 8—10 cm., and the shoots appearing from the scion variety and being etiolated by gradual earthing up, were used for getting them rooted. In about one year and a half, the shoots thus prepared and applied in lowland moisty soil being of marshy origin, took root in 52 per cent while rooting in sandy loam soil liable to get dry occurred in 35 per cent.

Part of the scions horizontally laid into the earth took root in marshy soil, too. When evaluating, it was found that 90 per cent of the rooted plant parts had developed into healthy plants.

Introduction

In the course of earlier experiments for getting the walnut rooted, seedlings had been used and thus no reliable data were available for showing how the method for walnut rooting as elaborated by ZATYKÓ (1956, 1959), could be applied on scions.

Due to their structure, the splitting of the scions meets with certain difficulties; this is partly due to the fact that the spot of grafting interferes with the proper performance of splitting, and on the other hand, the part of the shoot above the spot of grafting being of too thick pith tissue, — rough wounding often causes destruction.

It was with right to take as well into consideration the difference of juvenility between seedlings and scions. It is a well-known fact that in case of seedlings, the part above the collar, i.e. the part to be split is more juvenile than the corresponding shoot-parts of the scions. As for juvenility, it is generally known to be in close connection with rooting ability.

In order to elucidate the above-mentioned problems, in the spring of 1964 we started an experiment the test-plant of which was the walnut variety *Fertődi E. 1* propagated by way of green-house grafting.

Material and Method

In the course of pre-examinations it became evident that, due to the difficulties already mentioned in our introduction, the proper carrying out of splitting in the case of scions was far from being as simple as with seedlings. This was proved also by the result of rooting which

gave only little percentage. Therefore, in order to gain shoots being more suitable for splitting, the scions of at least 120 cm were placed in 8—10 cm deep furrows after their roots had been cut on one side. In that horizontal position they were fixed by the aid of hooks. The scions thus fixed, had been covered with a 5—6 cm earth-layer before frost set in. In spring, as soon as the shoots setting forth from the scions had got through this earth-layer, parallel with the growth of the shoots, the earthing up was increased so that the basic part of the shoots should be entirely etiolated. The shoots thus raised and being on their lower part at least 15 mm thick, were split at the most suitable time: in September or May (Fig. 1) The majority of the shoots were first split in May or September 1964 and then splitting was repeated in 1965. A detailed prescription of how the splitting is to be carried out, is described in the relevant works of ZATYKÓ (1957, 1959).

Fig. 1. Shoots being etiolated under gradual earthing up and appearing from the horizontally fixed part of the scion of the walnut variety Fertődi E. 1 right before splitting. The hand shows the spot of grafting

The experiment has been carried out in two different types of soil: in a lowland marshy soil with good water holding capacity and in a sandy loam soil that gets easily dried. There was no possibility for irrigation.

Evaluation was made in the spring of 1966. At this time those shoots were cut that had developed roots enough for independent living (Fig. 2, 3), or those which, though they had not developed root, however, — because of their getting too thick — their rooting or a further splitting could not be taken into consideration. The shoots having root were immediately planted after their having been cut from the mother-plant.

Results

The rooting results of the experiments carried out in soils of two different water balances, have shown considerable difference (Table 1).

From the data it appears that by laying down the scions and by etiolating properly the shoots breaking forth from them, from the scions, too, one might

Fig. 2. All the split shoots of the walnut scion have got rooted. Splitting: September 1964; evaluation March 1966

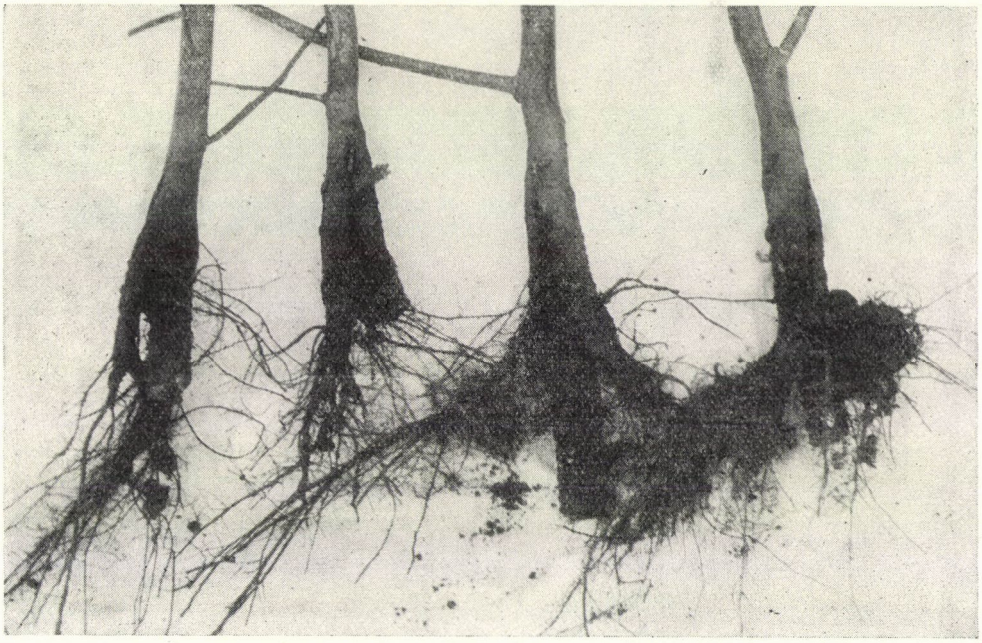

Fig. 3. The rooted parts after being cut from the mother plant

obtain plant-parts that will easily get rooted. The exact comparison of the rooting ability in scions and seedlings is, for the time being, an unsolved problem since in the case of seedlings it is inevitable to deal with a population consisting of genetically different individual plants.

Rooting obtained in a soil of relatively better water balance, has convenient production result also in economical point of view. The efficiency of the method is likely to be more improved through regular irrigation.

Fig. 4. In a moist soil of marshy origin horizontally laid parts of several scions that had been covered with earth, got rooted

The shoots were cut from the mother-plant in a way that on the scion laid down there should remain a stub of 1—2 cm. From the remaining stub

Table 1

The rooting of the walnut variety Fertődi E. 1. in soils of different water-balance

Type of soil	Number of split shoots/piece	Number of rooted shoots/piece	Rooting percentage
Sandy loam soil easily drying	212	75	35.3
Lowland soil of marshy origin	357	189	52.9

covered — right after cutting, — with a thin layer of earth there appeared generally more shoots and thus, in most probability, from the layer bed there can be cut more rooty shoots in the coming years. The increase of productivity of the layer bed seems to be due partly to the increase in the number of shoots that can be split, and partly to the fact that the new shoots being weaker because of their greater number, are of better rooting ability.

In the course of evaluation, beyond the data shown in the table, we have observed certain phenomena which might be applied in order to render the method of rooting even more efficient.

Fig. 5. The part that had, by accident, broken into two after being laid down; the part not being in connection with the mother-plant, has developed exceedingly strong roots

Quite independently from splitting, there were several cases in which the scion itself laid down into the earth, did take root. This phenomenon could be observed especially in moist soils of marshy origin (Fig. 4). On one occasion exceedingly strong roots were found on the scion. The outstandingly strong root formation was most probably enhanced by the fact that — due to some mechanical effect, — the connection between the root of the scion and the part laid down in the earth, had ceased to exist (Figs 5, 6). It is supposed that by the time the connection ceased, the split shoots had already started to be rooted. That coincidence is worth being brought about artificially.

Fig. 6. Rooted plant-part being separated from the mother-plant shown on the right side of Fig. 5

In October 1966 the number of surviving own rooted plants was evaluated. Out of 264 rooty plants 26 have perished meaning a 10 per cent loss which can well be considered as economical.

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ONTOGENETIC CHANGES OF NITROGEN METABOLISM IN VEGETATIVE PARTS OF MAIZE (ZEA MAYS L.) IN RELATION TO LOCATION AND DEVELOPMENTAL STAGE OF EAR

By

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Ontogenetic changes in the N-metabolism of a hybrid maize have been analysed as affected by the emergence of the female inflorescences. The protein content of the vegetative organs considerably increases in the period between shooting and milky ripeness. There are substantial divergences between the different levels of organs. The location and the developmental stage of the developing ear and the absence of grain formation, respectively, influence considerably the nitrogen content of the vegetative organs.

Introduction

Data on the nitrogen accumulation of maize are contradictory (FERENC 1958, HAY *et al.* 1953, HANWAY 1962, LATKOVICS 1963). This refers particularly to the changes in the vegetative organs occurring after pollination.

Therefore, in our present paper we examine the changes of the nitrogen metabolism in the hybrid maize stem and leaves occurring in the course of the vegetative period.

Material and Methods

The plant matter for our present investigations has been supplied by our previous experiment (PETHŐ 1966). Samples were taken before tasseling (June 17), at the time of tasseling (July 5), at the appearance of styles, at the time when flowering has ceased and when grains were in the milky stage. Samples have always been collected in the morning hours between 8 and 10 o'clock. The internodes and leaf-blades of 10—10 selected plants have been isolated and the main veins of the leaf-blades were removed. The organs having identical location on the selected plants constituted an average sample. After we had determined the fresh weight, the samples had been dried at temperatures not exceeding 50°C, and then stored in paper boxes until being worked up.

The determinations were made on air-dry ground samples. For amino nitrogen determinations the air-dry grist was extracted with 70 per cent alcohol several times. The amino nitrogen content was measured by way of the copper-ferrocyanide method of YASTREMBOVICH—KALININ (1962) in a Pulfrich photometer. Ammonium-, amide-, as well as nitrate-N was determined by the distillation method of VARNER *et al.* (1953) while total nitrogen has been estimated by the Kjeldahl method. The non-protein nitrogen was determined from the protein-free filtrate after the treatment of the aqueous extract with basic copper sulphate (BRUGOVITZKY 1956). The difference on the two latter results has given the amount of protein nitrogen. From the amount of the non-protein nitrogen the values of amino nitrogen were deducted and thus the amount of the other water-soluble nitrogenous compound was obtained. Analytical data are given in mg N/g fresh weight values.

The numbering of leaves and internodes was performed in acropetal sequence. By the time of flowering the lowest leaves have withered off. According to our numbering the upper ear was located in the axil of the 8th leaf. The internode below the leaf got identical number with the leaf.

Results and Discussion

The total nitrogen content in the leaf-blades of maize during the different phases of development is shown in Fig. 1. The total nitrogen content in the leaf-blades of vegetative plants (on June 17) as referred to the fresh weight, decreases acropetally, according to their individual age. Until tasseling (July 5) the total nitrogen content considerably increased in the leaf-blades. Upwards in the direction of the top, the N-content decreases also at this stage. The leaf-blade below the ear (henceforth called "ear-leaf") as well as that above it constitute an obvious exception of this tendency. At the time of flowering, all leaf-blades have about the same N-content with the exception of the highest few leaves as well as of the "ear-leaf".

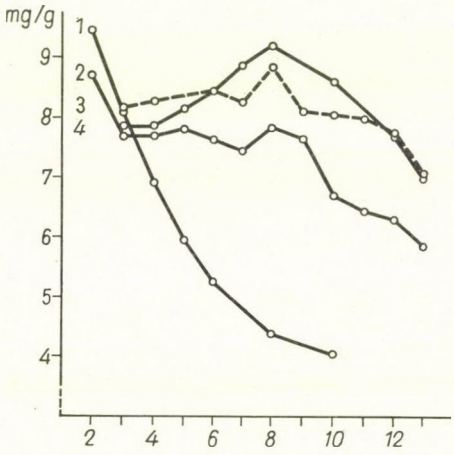

Fig. 1. Total nitrogen content in the leaf-blades of maize at the time of (1) shooting, (2) tasseling, (3) flowering and (4) milky ripeness. On horizontal axis the numbering of the leaf-blades acropetally

Up till flowering we might observe in case of each leaf-level the increase of the N-content. On the other hand, in the stage of milky ripeness the N-content of the lower leaf-blades is somewhat diminished as compared with that at flowering, while the upper ones show the same level. The N-content of the middle leaves — especially of those around the ear, — increases at that time, the maximum being shown by the "ear-leaf".

In the phases of tasseling, flowering and milky ripeness the total nitrogen in the internodes (Fig. 2) shows, basically, the same tendency as that of the leaf-blades. Differences are experienced mainly between organ-levels. As against the leaf-blades, at the time of tasseling the acropetal decrease in case of internodes is experienced only up till the internodes around the ear, while hence it increases. The least N-content can be found in the internodes around the ear. Until flowering the N-content of internodes also increases, however, the internodes around the ear do not show considerably lower N-content than the

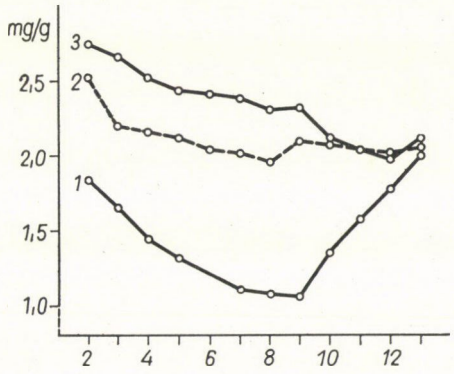

Fig. 2. Total nitrogen content in the internodes of maize at the time of (1) tasseling, (2) flowering and (3) milky ripeness. Acropetal numbering of the internodes on the horizontal axis

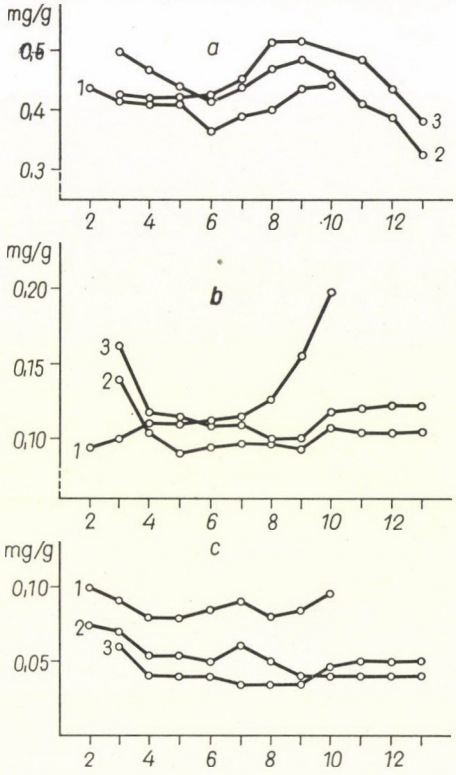

Fig. 3. The amino- (a), ammonium- and amide- (b) as well as nitrate-nitrogen (c) content in the leaf-blades of maize at the time of (1) shooting, (2) tasseling, and (3) cease of flowering

other ones. The tendency of acropetal decrease is experienced, referring to every internode, and in a definite manner, only in the stage of milky ripeness.

Analysing the kinetics of the N-forms, it can be established that the nitrate-N content of the leaf-blades of maize plants is higher during the vegetative period and it diminishes with advancing age (Fig. 3c). This agrees with

HANWAY's data (1962). In the case of ammonium and amide nitrogen (Fig. 3b) such definite tendency cannot be established. In the period before tasseling the quantity of these N-forms increases acropetally in the leaf-blades and is very high in the immature leaves. However, by the time of tasseling considerable decrease can be experienced. Later the concentration of these N-forms increases again. When taking samples at tasseling and at the cease of flowering,

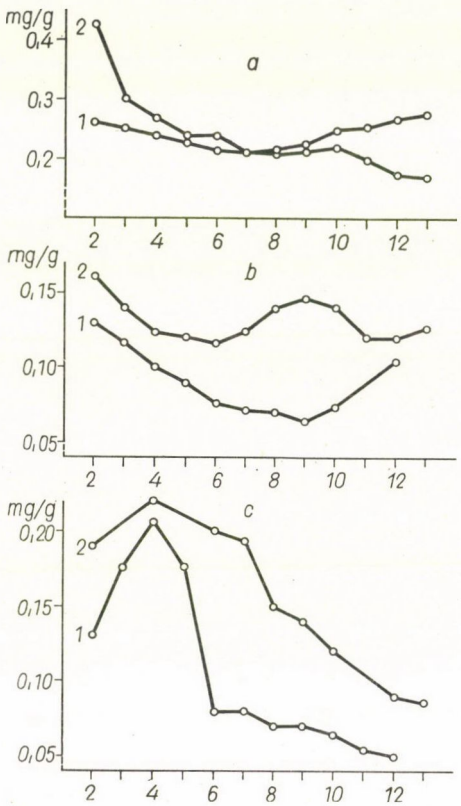

Fig. 4. The amino- (a), ammonium- and amide- (b) as well as nitrate-nitrogen content in the internodes of maize at the time of (1) tasseling and (2) the cease of flowering

the contradictory behaviour of these N-forms can most probably be explained by the increase of nitrate reductase activity of the leaves.

In the period examined the amino nitrogen content of the leaves (Fig. 3a) increases with age. At the time of tasseling and at the cease of flowering the leaves around the ear show higher amino nitrogen content as against the developing of the other soluble N-forms examined which, generally, is lower in the leaves around the ear. After tasseling the amino nitrogen content of the lower leaves decreases which might be the result of the reduced amino acid synthesis and shows itself in the lower protein content, too.

The analysis of the various N-forms in the internodes was performed only at the time of tasseling and at the cease of flowering (Fig. 4). It is noticeable that the nitrate nitrogen content shows the maximum in the fourth internode. From this on, at the time of tasseling it decreases abruptly, while at flowering off the decrease is moderate only.

HANWAY (1962) got similar data as to the changes occurring in the nitrate nitrogen content.

At the time of tasseling the ammonium and amide nitrogen content in the internodes showed the minimum around the ear. On the other hand, after flowering the concentration of these N-forms is higher in the internodes around

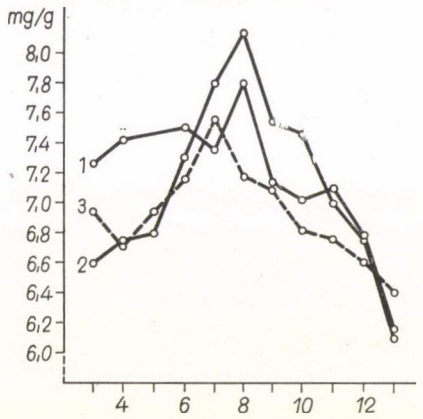

Fig. 5. The protein nitrogen content in the leaf-blades of maize at the time of (1) flowering and (2) milky ripeness as well as in the absence of pollination (3)

the ear than in the neighbouring internodes. The amino nitrogen level shows slight acropetal decrease at the time of tasseling. On the other hand, after the cease of flowering the internodes around the ear have the least amino nitrogen content.

From the analysis of the soluble N-compounds we might conclude that the N-supply of the maize has increased after tasseling. This appears particularly in the analysis of the internodes. Our hypothesis seems to be verified by the data of BERKO (1963), as well as of MOSOLOV — LAPSHINA (1964). After tasseling we might suppose a more active nitrogen metabolism. The data of Fig. 3 show the opposite changes of the examined N-forms in the period in question which allows us to arrive to the conclusion that enhanced nitrate reductase activity and more intensive amino acid synthesis are present.

The kinetics of N-content at the internode and leaf-blades around the ear seems to prove the assumption that the physiological activity of the leaves around the ear (as expressed in protein content) increases after tasseling, and the N-metabolism is more intensive as compared to the surrounding leaves. Our suggestion seems to be proved by experiment performed with phosphor

isotope by ZEMSKIJ (1959) from which we might conclude a close connection between the location and developmental stage of the female inflorescence and the physiological activity of surrounding leaves.

Covering the female inflorescence with isolating paper bags before silking, thus preventing the pollination and grain formation, we tried to study the effect of grain formation on the N-metabolism of the vegetative organs. As can be seen in Fig. 5, in the period from flowering to milky ripeness (grain formation) the protein content of the lower leaf-blades decreased with both plant groups. The protein nitrogen content of the middle leaf-blades increased with plants of normal development while in the case of unpollinated plants it decreased starting from the "ear-leaf". The protein content in top leaves did not

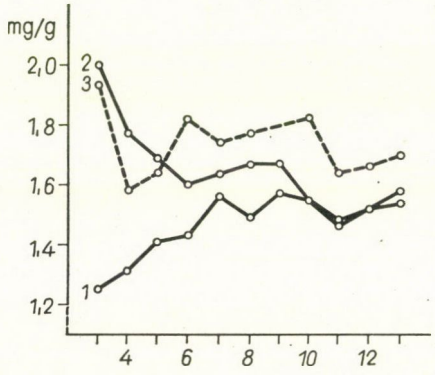

Fig. 6. Protein nitrogen content in the internodes of maize at the time of (1) flowering and (2) milky ripeness as well as in the absence of pollination (3)

change in the period of grain formation. The protein nitrogen content in the leaf-blades of plants being in milky ripeness shows a one-peaked curve, its maximum being in the blade of the "ear-leaf". This tendency is displayed as early as flowering. At that time, however, the protein nitrogen content of the neighbouring leaf-blades is lower. From the higher protein content of the leaf-blades around the ear one might conclude that they have a higher physiological activity.

The protein nitrogen content of internodes (Fig. 6) increases acropetally at the time of flowering, however, slight acropetal decrease can be observed in the phase of milky ripeness. The change in the protein nitrogen content of internodes is due to the fact that the protein accumulation of these organs decreases acropetally after flowering. Thus, while considerable increase of protein nitrogen content can be observed after flowering in the lower internodes, no such change has occurred in the upper internodes. The protein nitrogen content in the internodes of unpollinated plants is, generally, higher than that of normally developed plants which are in the phase of milky ripeness.

The non-protein nitrogen content of leaf-blades increases in the period of the grain formation (Fig. 7). This increase as can be seen in Fig 7b, is not due to the changes occurring in the amino nitrogen content. While the amino nitrogen content increases to some extent in the leaf-blades above the ear, the concentration of other nitrogenous components of non-proteinic character increases considerably in the leaf-blades under the ear. In the case of unpollinated plants, too, the different formation of the two nitrogen forms can be experienced. The amino nitrogen content in the leaf-blades of these plants increases considerably while the level of other non-proteinic nitrogenous compounds diminishes.

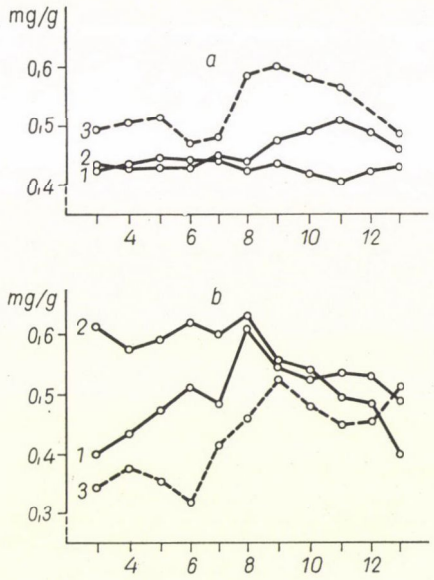

Fig. 7. Amino nitrogen (a) and other non-protein nitrogen (b) content in the leaf-blades of maize at the time of (1) flowering and (2) milky ripeness as well as in the absence of pollination (3)

It would be difficult to determine the cause of these phenomena on the basis of statical investigations. It can be assumed that in the leaf-blades of unpollinated plants the intensity of protein synthesis has decreased and the synthesized amino acids have accumulated.

In the non-protein content of internodes (Fig. 8) an increase can be experienced with both plant-groups during the post-flowering period. This reveals itself primarily in the amino nitrogen content. It might be assumed that at the time of grain formation more amino nitrogen is migrating from the root into the organs above ground; this is also proved by the decrease of other non-proteinic N-compounds.

This observation agrees with the data of MOSOLOV — LAPSHINA (1964)

who experienced the increase of the proportion of organic nitrogen in the bleeding sap of maize in the period in question.

The acropetal decrease of the other non-proteinic N-content of the internodes observed at the time of flowering, allows us to conclude that the N-supply taken up by roots and translocated to the internodes for the N-metabolism of the leaves, is used up gradually; thus there remains but little for the supply

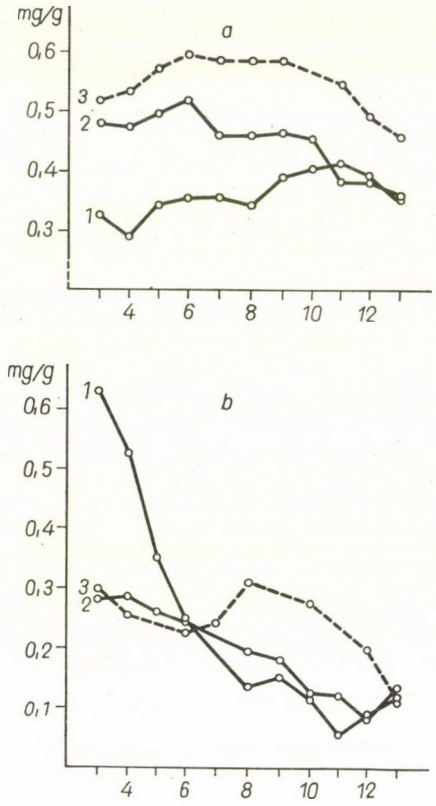

Fig. 8. Amino nitrogen (a) and other non-protein nitrogen (b) content in the internodes of maize at the time of (1) flowering and (2) milky ripeness as well as in the absence of pollination (3)

of the highest internodes. At the time of milky ripeness, too, there can be experienced acropetal decrease, but the initial concentration in lower internodes is considerably less and the curve is not so abrupt. Most probably, this phenomenon can be attributed to the fact that in that phase the protein content of lower internodes is higher and, presumably, this has got realized at the expense of the previous N-form. Such essential differences in the amino nitrogen content between the internodes cannot be observed.

The above assumption is supported also by the lower protein nitrogen content in the leaf-blades of unpollinated plants. With these plant-groups where no grain formation occurs, the N-supply accumulates in the internodes. Similarly to the normally developed individuals, the other non-proteinic N-compounds of the older internodes, decrease. This phenomenon contradicts the hypothesis according to which this N-form of the lower internodes is supposed to be transferred into the grain.

Conclusions

The nitrogen metabolism in the hybrid maize *Martonvásári 1* has been analysed on the basis of data referred to the fresh weight of the nitrogen forms in the internode- and leaf-levels.

The total nitrogen content of leaf-levels increases considerably in the period between shooting and milky ripeness proving intensive nitrogen accumulation in this period. In the period between flowering and milky ripeness the N-content increases only in the leaves around the ear, while it decreases in the lower leaf-blades.

In the period between tasseling and flowering there occurs considerable N-accumulation in the internodes which continues, at a moderate rate, till milky ripeness. This period is characterized by the acropetal decrease of the N-content in the internodes, while at the time of tasseling it is the internode around the ear that has lower N-content.

From the alteration of soluble N-compounds the conclusion may be drawn that at the time in question nitrogen metabolism gets more active in leaf-blades, the nitrate reductase activity presumably increases (low nitrate content), the intensity of amino acid and protein synthesis increases.

The analyses of the soluble N-compounds in the internodes show that in the period between tasseling and cease of flowering the quantity of nitrogen taken up by the root-system and translocated into the stem, increases. This hypothesis is supported by the data of BERKO (1963). Though the N-quantity referred to the unit of active absorbing surface does not change considerably in the bleeding sap, the N-supply of the organs above the ground still increases under optimum water supply conditions because the size and the active absorbing surface of the root-system increase considerably after tasseling.

At the time of milky ripeness the higher protein content of the leaves around the ear is presumably connected with higher physiological activity. This assumption is supported by the data of ZEMSKIJ (1959). Such increase of the protein content in the leaf-blades around the ear, does not occur in absence of grain formation which, in agreement with the data of ZEMSKIJ (1959) proves the close relationship between the physiological activity of the leaves and the

position as well as the developmental stage of the female inflorescences. The existence of this relationship is also a condition of the correlation between the N-content of the leaves around the ear and the yield (BAIRD *et al.* 1962). Contrary to the leaves, the protein accumulation of internodes decreases acropetally in the period between flowering and milky ripeness.

The absence of grain formation leads to the accumulation of amino nitrogen in both the internodes and the leaf-blades. In accordance with the changes occurring in the protein content, from this we might conclude that grain formation induces higher protein synthesis in the leaf-blades, — its absence results in the accumulation of the amino nitrogen. From the analysis of the soluble N-compounds in the internodes it can be concluded that during the period between flowering and milky ripeness the proportion of amino nitrogen synthesized by the root-system and moving into the organs above the ground, increases.

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EFFECT OF METHYLTHIOURACIL ON THE FATTENING OF BEEF CATTLE AND ON THE QUALITY OF THE MEAT

By

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We have tested a methylthiouracil preparation produced by a West German firm and sold under the brand name MEYKO on 10 spotted Hungarian beef bulls above one year of age in order to discover whether this preparation increases the weight gain of bulls kept on an identical diet and if it does, to what extent. After feeding the active agent for 35 days the test animals showed a weight gain of 65 kg in comparison to the 40.2 kg gain of the control group. After the test period the experimental animals were kept on the normal ration of the control group (without agent) and there was a drop in their weight during the subsequent 30 days of feeding.

The preparation improved the beef quality and the flavour of the meat; the meat had a better taste and its colour was more desirable. It seems worthwhile to give this preparation to the animals in the last period of fattening if they are immediately slaughtered after the termination of the treatment.

Introduction

In order to further increase the conversion efficiency attained previously in cattle fattening it is necessary to test such active agents that make feeding more economical and improve the feed conversion efficiency. Therefore the testing of the West German (G. Meyer, Till) methylthiouracil preparation (MEYKO) seemed justified especially because in Hungary experiments previously carried out with similar preparations had proved to be unsuccessful.

Already in the '40s materials had been studied which by the depression of thyroid activity attempted to suppress metabolism and consequently to increase the weight of the animal. ASTWOOD (1943) stated that thiouracil is an anti-thyroidal material which results in the hypofunction of the thyroid gland, i. e. thyreo-inhibitor. He also stated that the intake of these preparations over a longer period of time may lead to the formation of goitre and doses of such preparations lead to the overgrowth of the thyroid gland. According to TANGL (1956) thyouracil hinders the iodine fixation of thyroxin and as the thyroxin content of the blood is reduced in the anterior lobe of the pituitary gland an increased amount of the thyreotrop hormone is synthetised. REINECKE *et al.* (1942) have carried out experiments with thiouracil mixed in fodder for roosters and they stated that the carcass quality of roosters fed the chemical was in 78 per cent first class, while only 50 per cent of those animals not fed the agent had good meat quality. ANDREW *et al.* (1947) have made similar experiments on

sheep. By feeding thiouracil to the animals they obtained excellent quality meat in 57 per cent of the cases in comparison to 35 per cent of the control animals. MUHRER *et al.* (1947) experimented on swine. They succeeded in raising the daily weight increase from 0.7 to 1.0 kg and what is even more important, the 4.8 kg of feed necessary for all kg increase in live weight was reduced to 3.1 kg due to the effect of the chemical. In another experiment 24% less feed was necessary when 0.1 per cent thiouracil was mixed into the fodder. According to TANGL (1956) it is useful to apply 0.1—0.15 per cent thiouracil during the last 4 to 6 weeks of the fattening period. As we shall see from the experiment described below, this statement is of decisive significance if the correct application of the active agent comes into question. According to LENKEIT (1952) the intake of thiouracil might result in the same morphological changes as a vitamin A deficiency because the chemical blocks the effect of the thyroid gland on carotinase ferment.

Experimental Procedure

At the Sződliget branch of the Alag State Farm we selected two groups of 10 each from the 100 young spotted Hungarian bulls not entirely homogeneous as regards age and appearance. We selected them so that there was at most a 1—2 per cent difference in initial weight between the individual test and control animals. The difference in the total weight of the two groups was under 1 per cent. Their condition, age, and quality were also balanced. Although this small number of animals does not permit an objective comparison, the observation and evaluation of the effect of the preparation may still be of interest.

	Average initial weight in kg
control group	460
test group	459

There was no significant difference between the initial weight of the two groups:

$$t = 0.12$$
$$P\% = 90$$

Since the individuals of experimental groups had been previously in other stables and formations after the new grouping they received their normal diet for six days in order to get them accustomed. The testing period and the feeding of the chemical began on the 7th day. According to prescriptions received the preparation containing methylthiouracil in prepacked individual daily doses weighing 50 grams each (and containing 5 grams of the chemical) was mixed into the feed of each individual animal immediately before feeding. Since the structure of the crib and the method of fixation of animals were also favourable for individual feeding, each animal could only eat its own portion and was not able to take the feed of other animals.

The test and control groups had the same amount of identically composed ration. The composition of the ration was as follows:

15 kg maize silage
15 kg sliced sugar beets
3 kg lucerne hay and
4 kg fodder mixture

During the experimental period the composition of this latter was altered once, but since both groups received the same feed this condition does not have any great significance.

The feeding of the agent was done for 35 days according to the prescription provided by the factory.

The animals were weighed before and after the test period as well as 30 days later in order to find out whether the chemical had any ulterior effects on the weight gain of the animals and if so, what these effects were, etc.

At the end of the test period there was a test slaughter in order to examine beef quality and ten days later the same examination was performed after slaughtering additional test animals. We also examined the meat flavour and then in order to establish meat quality objectively, the meat was examined in the laboratory, too.

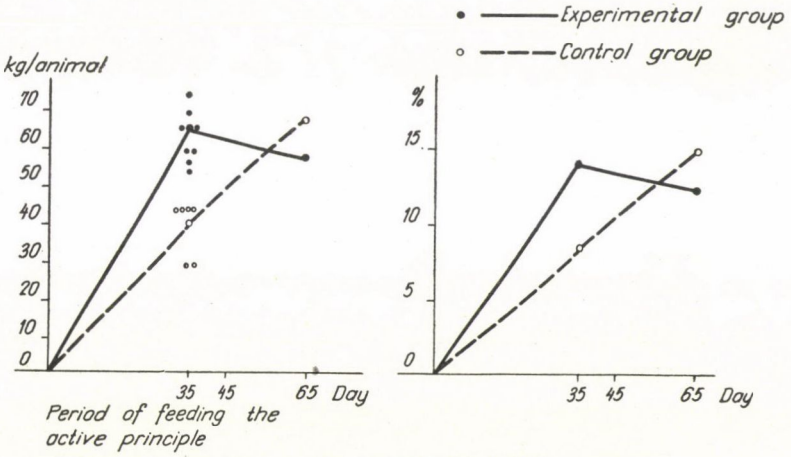

Fig. 1. Experiment using MEYCO for bull fattening

Results

At the end of the feeding experiment the animals were weighed which made evident a surprising average weight gain per animal:

		Weight gain		per cent
		total	g/animal/day	
Control group	kg	40.2	1.140	100
Test group	kg	65.0	1.850	162

According to statistical analyses the weight gain of the test group was significantly higher than that of the control group:

$$t = 4.9$$

$$P\% = 0.1$$

It was to be feared, however, that after stopping the dosis of the chemical there might be a declination or the ulterior effect of the chemical might have an unfavourable influence on further weight gain. For this reason we continued feeding the test animals for an additional 30 days on the normal ration of the control animal.

The results of the weighing done on the 65th day after the beginning of the experiment (Table 1) proved the reality of this supposition.

Table 1

Weight increase

	Average weight			Average weight increase			Weight change	
	At beginning kg	On 35th day kg	On 65th day kg	1—35th days kg	35—65th days kg	Total kg	drop between the 35th and 65th days kg	in the 65-day period
Group:								
Test	464.0	529.0	522.0	65.0	— 7.0	58.0	7.0	+12.4
Control	457.3	497.5	525.6	40.2	28.1	68.3	—	+15.0

Statistical analyses show that a significant difference exists between the weight relations due to the respective loss or gain of the two groups in the 30 day period following the cessation of the dosis of methylthiouracil:

$$x = -5.5 \qquad 28.3$$
$$t = -70.7$$
$$P\% = 0.01$$

This clearly proves that the active agent actually contributes to gain by depressing the metabolism during the period of its application, but later, when the doses of the compound are stopped, not only does the weight gain stop, but an unfavourable effect influences the further weight increase of the animal.

Therefore no ultimate significant differences in weight gain can be found between the two groups during the 65-day feeding period, i. e., during and after the testing because

$$t = 1.32$$
$$P\% = 20$$

From the viewpoint of rentable beef production, the use of this chemical is suggested only in the last period of fattening and when animals are slaughtered immediately after stopping the treatment.

In this case, therefore, we can count on a rather high extra increase in weight which, if the preparation is supplied for a favourable price, may contribute to the profitability of fattening the animals.

The price of the daily dosage for an animal is 33 DM (for a 35-day period) which equals 230 Ft (1 DM = 7 Ft). On the other hand, taking into consideration the 19 Ft wholesale price of first class cattle this equals to 12 kg of weight. Since according to the present trial the methylthiouracil feeding resulted in 25 kg weight plus, 12 kg as drugvalue subtracted, 13 kg net weight gain appears as final profit. Calculated on the same basis this means a profit of 240—250 Ft per animal.

We also found that the weight loss takes place a short time after stopping treatment with methylthiouracil. This is proved by the weights of the animals slaughtered 10 days after the test feeding. The average weight loss of these animals corresponds to that of the animals weighed 20 days later.

From this it follows that the chemical affects the weight gain of the animal for a relatively long time after stopping the intake of the agent. It has a negative influence on the normal physiological processes because afterwards the animal does not have a weight gain corresponding to the amount of fodder intake.

Finally it can also be stated that the differences in the initial weight do not influence the weight increase or reduction and the positive or negative effect of the compound.

Immediately after the test period we had slaughtered the test bull showing the greatest weight increase and a control bull having an average weight increase at the Budapest slaughter house in order to find out the net beef "rendement" by examining the net beef weights or percentages and in order to establish the beef quality with subjective methods.

On the other hand we attempted to pass an objective judgment on beef quality in the laboratory.

Ten days after the end of the test feeding 4 additional test bulls and 1 control bull were slaughtered for similar purposes.

According to the opinion of a committee of experts (consisting of members of the Ministry of Agriculture's Inspectorate of Animal Breeding, the Meat Industry Trust, Research Institute for Animal Husbandry, Research Institute for the Meat Industry, veterinarians of the Slaughter Houses, etc.) participating in the test as well as the experts of the slaughter house, the meat of the test animal was finely marbled while that of the control animals was not. The results of the examination for beef quality may be seen in Table 2.

According to the data of Table 2 there are no striking differences in net beef gain percentages. The amount of suet measured was generally somewhat more than 15.8 kg, in case of the test animals, while for the controls it averaged 14.7 kg.

Table 2

Net beef gain data

	Live weight		Killing-out-results			
	At start of experiment kg	Before slaughter kg	Halved kg	Halved %	Suet kg	Hide kg
Test	466	533	280	52.5	18	55
	431	472	261	55.0	13	45
	456	478	264	55.0	16.5	53
	486	521	280	54.0	17	51
	431	470	260	55.0	14.5	49
Control	471	496	271	54.5	13	47.5
	471	510	275	54.0	16.5	53

There were even less differences in the weight of the hide because the average hide weight of the test animals was 50.6 kg, while that of the control was 50.2 kg.

The committee of experts participating in the flavour test declared (9 to 2) that the dish made of the meat of the test animals is finer, more tasty than the identically prepared dish from the meat of the controls. It should be pointed out that the dishes were variously coded so that the members of the committee discovered only at the end of test which meat they qualified as the better.

The results of the laboratory examinations may be seen in Table 3.

Table 3

Results of laboratory examinations

		Dry-matter %	Crude protein %	fat %	ash %
Test:	Sirloin	23.3	20.5	1.4	1.2
	Rump	22.4	19.18	1.3	1.2
	From animal butchered 10 days later	22.5	20.0	1.3	1.1
		22.4	19.8	1.4	0.9
		22.9	20.0	1.6	1.2
		22.2	19.4	1.6	1.1
Control:	Sirloin	23.9	21.5	1.0	1.3
	Rump	23.6	21.2	1.0	1.2
	From animal butchered 10 days later	23.2	20.7	1.2	1.2

The figures show that there was a significant difference with the exception of fat content which was slightly higher among the test animals than that among the controls.

There was no essential difference in dry matter and crude protein content. All the differences in protein were within the usual limits of protein content. If we take into consideration the exactitude of the method of examination the results does not suggest essential differences within the possible margins of error.

The laboratory examinations also confirmed the findings which the macroscopic examinations at the slaughter house had showed, i.e. the meat of the test animals was more evenly marbled, the fat fibres thinner, finer and more evenly distributed in the connective tissue and finally, the colour of the meat was unusually brighter than that of the control animals.

Conclusions

Considering the results above it would be advisable to repeat the experiment on a larger scale in such a way that the chemical should be given for 35 days during the last phase of the fattening period. In this way the actual extra weight gained due to the intake of the preparation would lead to the success or profitability of the feeding. It also seems necessary to see whether the proved weight increase could be continued by a longer feeding period of the chemical in order to even more greatly increase the profitability of the process.

Finally, we express our gratitude to Mrs. A. Csukás, the Mathematical Research Institute of the Hungarian Academy of Sciences for carrying out the statistical analyses.

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PROSPECTS OF THE DWARF HYBRID MAIZE (ZEA MAYS L.) IN HUNGARY

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The growing of the dwarf maize is justified by its many advantageous properties — higher yield obtained with dense spacing, resistance of the stalk to breaking, to falling and to lodging, drought-tolerance, as well as its applicability for mechanized gathering. Our experimental results gained in this country verify these good properties of which the most important is the higher yield gained with smaller spacing.

Introduction

Hungary belongs to the countries where maize is a very important basic fodder our growing conditions being good and our requirements high. Therefore, we have to do our best in the interest of increasing the yield and for improving yield-security.

The experiences obtained on dwarf hybrids go back only to a rather short past. The dwarf mutants appearing in maize, — the majority of the present dwarf maize come of these, — have been tried to be included into breeding only recently. To this it is to be ascribed that the material is still small and not variable enough.

According to literary data, opinions on the future of the dwarf hybrid are different (LANZA 1960, LENG 1958, LENG—SPRAGUE 1960). The wrong with it is that the yield capacity of the individual plants lags behind that of normal maize.

Its positive properties surpass the defects many times.

1. One can produce of the dwarf maize by 50 and even by 100 per cent more individual plants on a unit area than of the normal maize. CHARLES (1960) renders account on the experience that on one ha (hectare) even 170 000 plants can be grown safely and it is this way the dwarf gives high yield. LENG (1958) speaks in his paper of a 10 per cent yield surplus as compared with the normal-growth American hybrid having the highest yield. From the Soviet Union HADSHINOV — KAZANKOV (1965) report even on a 10—15 per cent yield surplus in the case of such dwarf hybrids where the crossing had been made with related lines.

2. Dense sowing is a better system to check the growth of weed, and the resulting more shade decreases the exhaling of the soil as compared with thin-

ner sowing. Therefore, the dwarf hybrids might also have important role under dry conditions because on such areas they make more economical use of soil moisture (HADSHINOV — KAZANKOV 1965).

3. It is generally agreed that the falling and lodging resistance of the dwarf-hybrids is much better than in the case of hybrids of normal height (ANDERSON — CHOW 1962, LENG 1957). That property is one of the main bases of enhancing the security of yield. We have by all means to reckon with changeable weather conditions. Hybrids with long stalks are much more exposed to strong winds, shower-like rains and storms than the shorter plants. When, on the other hand, we want to grow such strong-stalked high maize which resists well to the hardships of weather, we have to make the stalk thicker and by doing so we also increase the undesirable ballast. It seems to be more practical to enhance the strength of the stalk parallel with the shortening of the stalk (LENG 1958).

4. The resistance to lodging and to falling off greatly contributes to the more efficient mechanical gathering. From the standpoint of mechanical gathering it can be a considerable advantage that the ear of the dwarf maize is located much more evenly and in a lower zone (ANDERSON — CHOW 1963, EVERLY — PIBLER 1959).

The advantages enumerated above justify the breeding of the dwarf hybrid under our conditions, too.

The types of dwarfishness. — In maize breeding we seldom come across properties being heritable simply. That might be considered a regrettable fact because such characteristics are better studied genetically than properties inherited in a complicated way.

Dwarfishness is also determined by several genetical factors. The simplest case is that of being caused by recessive genes which, when in homozygote state, are sure to result in dwarfishness.

The three most frequently occurring types of genetically established dwarfishness are reported on by LENG (1957):

1. The real dwarfs are exceedingly low, their stalk has become thick. Each of their organs has become very shortened. Their sexual organs are considerably changed. The decrease of their vigour and productivity is characteristic. The vegetative period is very long.

2. Compact dwarfs, the organs of which get smaller proportionally.

3. Brachytic dwarfs; it is the internode below the ear that becomes especially short. Concerning growing viewpoints, the Brachytic-2 is the best known and the most used.

Besides these quite a series of dwarfishness of different type is known.

PHINNEY (1961) described five variations of dwarfishness. All of these are caused by recessive mutant allels. Each of the different dwarfishness brings

forth gibberellin levels of different rates in the plant and as a consequence, the rate of dwarfishness will also be different.

The mutations bringing about dwarfishness of maize have been studied by several breeders. It has been established that two basic genes determine brachytic dwarfishness that is most used in growing.

The feasibilities in producing dwarf hybrids. Dwarfishness (nanism) can be produced with induced mutagenes. In this case we might rely chiefly upon two kinds of effect: partly on the different forms of radiations (X-ray, gamma, etc.), partly on chemical (cholchicine, nicotine, etc.) treatments. On might try also to apply heat-treatment and perhaps special mechanical effects.

Though less probable, however, there is a possibility for finding dwarfs through spontaneous mutation, too.

After having selected the starting material, there are two feasibilities available for the breeder in producing the dwarf hybrid: partly the self-pollination of the dwarf basic material and its dividing into lines from which different combinations might be produced; partly the introduction of dwarfishness as a property, into the basic material of normally high hybrids already known. These two cases are the limiting value of the possibilities. Besides these, there might be imagined and realized solutions of many a combination.

Material and Method

In this country it was in 1961 that dwarf hybrids were tested in experiment. A dwarf hybrid coming from America was seeded with the usual spacing (80 × 60, in every second hill two plants) among the test hybrids. The result was not promising. In the next year (half of the material had been stored) with dwarfs the spacing was decreased (80 × 40 cm, in the same way as with the former case, 1 : 2 : 1 plants per hill); the *Mv. 1* hybrid used as standard, and being seeded with the usual spacing, the result became already a surplus yield of 10.9 per cent (Sz. D. 11.8%) to the advantage of the dwarf. That promising result was the basis for continuing and expanding our work.

For producing dwarf hybrid, the basic material had been collected and then inbred strains were produced (yearly two generations). When the lines had got equalized, we performed test crossings. Crossings also included crossings between dwarfs and those with well known lines of normal growth. A small part was sown in comparative experiment in order to get an answer concerning the successfulness to be expected from our work.

For the sake of as much reliability as possible, the experiments were set in a manner according to which each plot sown with dwarf and dwarf × plants of normal height (two rows), respectively, had on both sides a plot (also of two rows) of the standard *(Mv. 1)*. The number of hills on the plots was different. In the case of *Mv. 1* 80 × 60 (one and a half plant), in the other cases — in compliance with the crossings — 80 × 40 (also one and a half plant). This means a 32 per cent decrease in spacing.

Depending on the quantity of seed available, we had experiments of three and four series. In the experiment described four single crossings were included. In three cases the experimental material was made up by the crossing of dwarf lines with normal growth line while in one case this was a crossing between a dwarf line with another dwarf line.

Fig. 1. Difference in height of the hybrids as compared to the standard *Mv. 1*
N = normal D = Dwarf

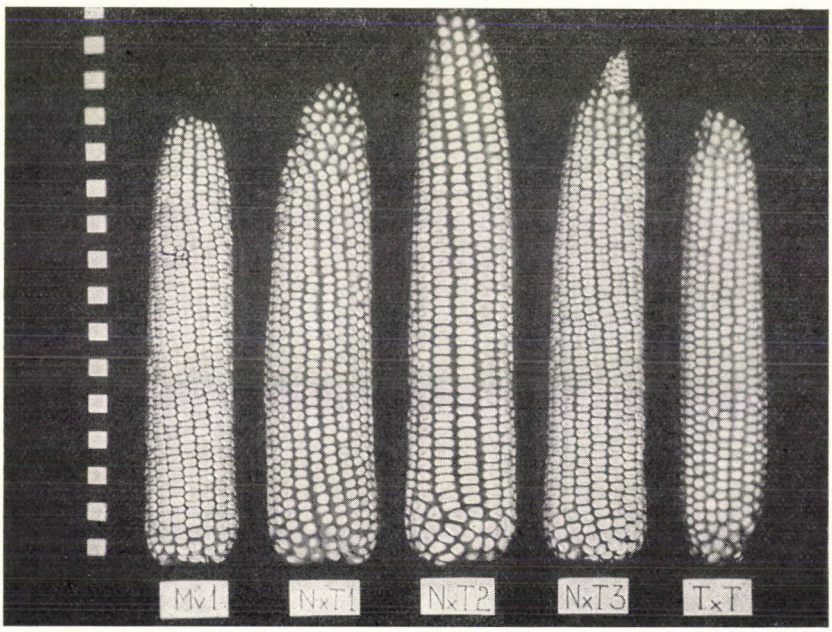

Fig. 2. Comparison of the average ear-yield in the hybrids

Results

The observations have been carried on continuously from the beginning of the growth period. At the beginning nothing peculiar could be perceived in the stand while later, due to much precipitation in that year, the *Mv. 1* standard variety became very high, almost suppressing the dwarf crossings. Later on the dwarf and especially dwarf x normal crossings have grown considerably or rather, have become lengthy so that the difference in height as compared with the standard, got decreased. This observation deserves attention because in the case of normal x dwarf crossings — since dwarfism is determined by recessive genes — in the F_1 generation we ought to have obtained high plants only, and yet there was a considerable difference between *Mv. 1* and the crossings. Suckering was different with each combination, however, on the suckers no primordial ear has developed. At the time of maturing it could be established that contrary to *Mv. 1* — which, together with the yield of the suckers, produced 2,8 ears per plant, however, except one they were stunted (ear production of the sucker), — the dwarf hybrids produce only one ear per plant. These ears, on the other hand, are well developed and big which was also in the raw yields (Table 1).

Evaluation has been performed in such a way that the yield of a plot has always been compared to the average of the standard plots being on both sides of the hybrid in question. We were also keen to know the number of nodes in the stalk of the produced dwarf hybrids and the thickness of the stalk, this

Table 1

A comparison of the raw-yields of the combinations

Hybrid and combination respectively	Time of flowering	Yield of the main stalk	Yield of suckers	Total in the St%
		in the % of total yield		
N×D. 1	July 29	100	—	121
St.	July 31	81	19	100
N×D. 2	July 30	100	—	132
St.	July 31	77	23	100
N×D. 3	August 3	100	—	121
St.	July 31	79	21	100
D×D	August 4	100	—	96
St.	July 31	84	16	100

N = normally high. D = dwarf

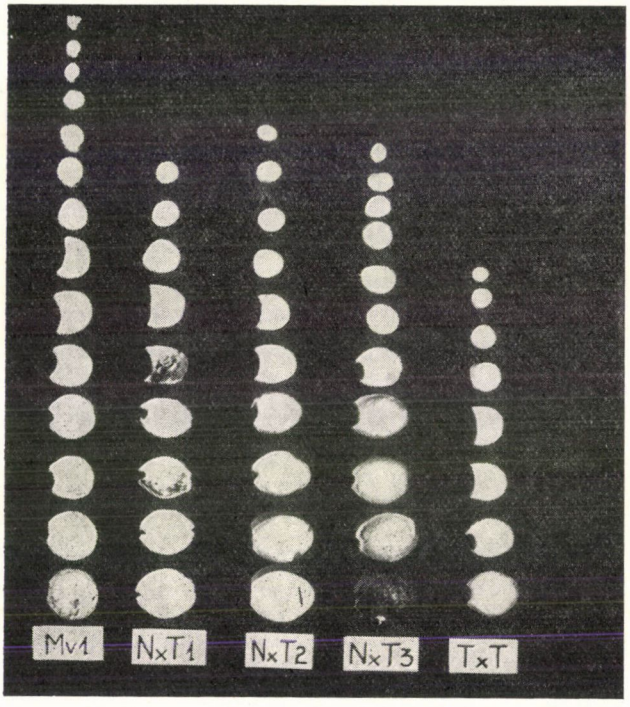

Fig. 3. Number and thickness of the internodes

being the best criterion of stalk-strength. The results of the investigation are shown in Table 2.

After drying the ears, the dry kernel yield has also been worked up and the results have been summarized in Table 3. (The evaluation has been performed similarly to the previous one.)

Table 2

Measurements of stems

Variety	Plant height cm	Number of internodes	Average thickness					
			1	2	3	4	5	6
Mv. 1	260	14	2.77	2.70	2.51	2.43	2.39	2.38
N×D. 1	190	9	2.93	2.65	2.62	2.61	2.38	2.22
N×D. 2	220	10	3.14	3.03	2.74	2.47	2.38	2.22
N×D. 3	200	11	3.05	2.11	2.62	2.59	2.31	1.94
D×D	185	8	2.79	2.62	2.58	2.48	1.77	1.46

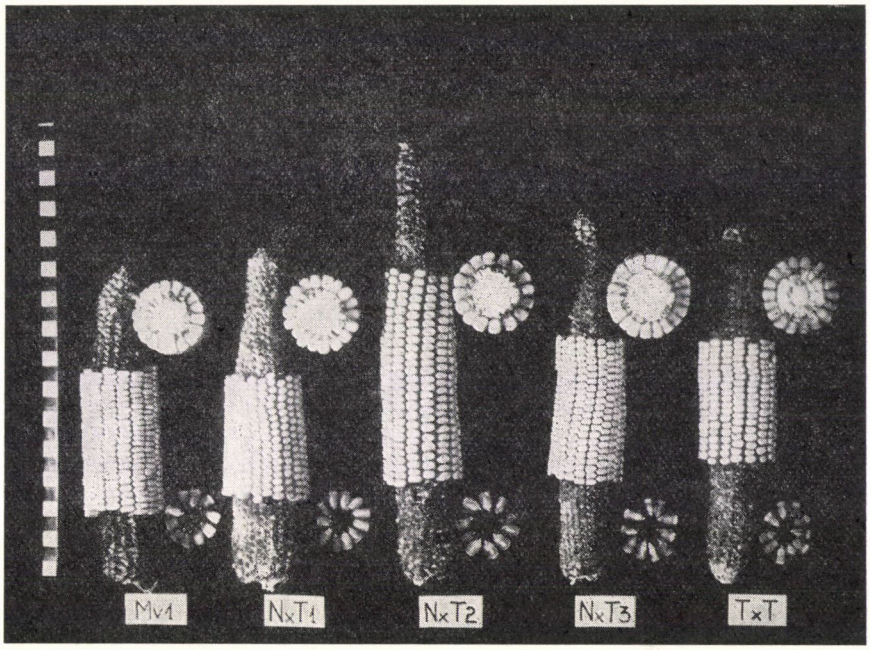

Fig. 4. Cross section of the ear-yield, cob and kernel: comparison

Conclusion

From the results it can be seen that similarly to the experiments of HADSHINOV—KAZANKOV (1965) the single hybrid effect of the dwarf being produced from the related lines, does not yet achieve that of the produced hybrids. On the other hand, the hybrids coming from the normal x dwarf line give promising result.

Since the experimental results are only of informative character, it wouldn't be proper to draw far-reaching conclusions and yet, we definitely are of the opinion that it is a new possibility for the future, to include the dwarf

of internodes, cm									
7	8	9	10	11	12	13	14	Total average	Average length
2.07	1.82	1.56	1.48	1.17	0.91	0.73	0.71	1.83	18.6
1.95	1.48	1.23	—	—	—	—	—	2.23	21.1
1.75	1.48	1.38	1.23	—	—	—	—	2.17	22.0
1.91	1.54	1.32	—	1.01	—	—	—	2.02	18.2
1.24	1.12	—	—	—	—	—	—	2.31	20.1

Table 3

Values of the dry grain yields in the combinations

Hybrid and combination, respectively	Drying %	Shelling %	1000 grains weight	Grain yield, % of *Mv. 1*
N×D. 1	18.1	81.8	271	113
Mv. 1	19.4	86.3	308	100
N×D. 2	16.3	86.7	388	126
Mv. 1	18.9	86.5	301	100
N×D. 3	19.9	84.9	278	118
Mv. 1	19.2	86.1	304	100
D×D	20.8	80.1	287	93
Mv. 1	19.1	86.6	298	100

lines into maize breeding. If we add to the above mentioned that the dwarf shows more drought-tolerance and that, due to its strength of stalk, yield security is greatly increased and mechanical harvesting is simple — it seems to be definitely justified to deal, more intensively, with the dwarf hybrid maize or with producing different combinations of the dwarf and normal maize.

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TIME OF HARVESTING AND YIELD OF KENAF (HIBISCUS CANNABINUS L.)

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In general, late harvesting has increased the green yield per acre. The fibre production tended to increase from the opening of the first flowers to maturity.

Introduction

The time of harvest for fibre production depends upon several things. If fineness and lustre are wanted at the expense of yield and little fibre strength, the stems should be harvested when the flower buds are initiated, but if a high yield of strong harsh fibre is required, then harvest should be delayed until plants attain maturity and are losing their green colour. But to obtain a high yield of good quality fibre which is strong, silky and lustrous, and which might compete with the better qualities of jute, harvesting must be carried out during the flowering stage when the first flowers have opened and before seed has been formed (Imperial Institute, London, 1930, EL KILANY, 1939, CRANE—ACUNA 1945, DAVID 1948).

EVANS (1917), WALTERS (1920) and KOCH (1948) mentioned that for fibre production the crop was usually harvested not earlier than the ripening of the first seed pods and while the upper portion was still in flower, whereas KOLBÉ (1952) mentioned that the best time for cutting the crop was from two to three weeks after the first flowers have opened and before the seed bud has hardened.

In Alabama ERGLE *et al.* (1945) found maximum development of the fibre at 126 to 147 days, whereas GANSTAD *et al.* (1951) and SEALE *et al.* (1952) mentioned that kenaf for fibre production in Florida should be harvested 100—125 days after planting. That because the per cent yield of fibre increases rapidly up to about 100 days maturity and at 125 days the plant soon becomes too mature for easy removal of the fibre, and the quality of the fibre deteriorates.

In college, Leguna University of the Phillippines, FELIX (1957) reported that plants allowed to attain maturity and harvested when 143 days old were significantly taller than plants harvested at 113 days having 1—2 flowers in

bloom and those in full bloom harvested at 123 days old. The yield of dry fibre was significantly higher at 123 days (plants in full bloom) than at 113 day old plants, having 1—2 flowers. At the maturity stage (143 day old plants) the bark became dry and could hardly be separated from the wood.

On the other hand, OSSEWAARDE (1952) mentioned that for estimating the best time for harvesting the varieties of Java group in South Africa a number of individual plants had been marked about one week after the first flowers were observed and their height measured once a week. When no further increase in length has been observed, harvesting can begin.

Materials and Methods

In 1962 season an experiment was held at the farm of Istituto di Allevamento Vegetale per la Cerealicoltura at Bologna Italy to investigate the effect of time of harvesting on the yield of kenaf. Three dates of sowing were used. These were April 27, May 12 and May 27. A light argillaceous soil which had previously been planted to wheat, plowed to depth of 40 cm with a tractor and harrowed twice. The farm yard manure at the rate of 11 tons per acre was added to the land before plowing in August 1961. Mineral phosphate containing 15—20 per cent P_2O_5 at the rate of 325 kg to an acre, and ammonium sulphate containing 21 per cent nitrogen at the rate of 130 kg to an acre were spread in March 1962. The field was laid to a randomized split plot design, with the date of sowing as main plots. The main plot was divided into three split plots for the time of harvesting. Each treatment was replicated three times. The size of the split plot was 1/1400 acre (i.e. 8 rows of 20 cm and 2 meters long). At a rate of 14.28 kg/acre for fibre production, 13.6 grams each plot was seeded of kenaf seed variety Tingo Maria. The planting distances were 20 cm between rows and 5 cm between hills in the row. All plots were weeded three weeks after planting.

The meteorological data during the experiment were:

Month	Temperature (C°)			Precipitation in mm.
	Max.	Min.	Mean	
April	18.3	6.1	12.25	89.2
May	22.4	8.9	15.65	36.7
June	26.2	14.7	20.5	64.2
July	28.7	15.2	21.9	44.5
August	32.4	18.4	25.4	3.5
September	26.9	14.3	20.7	14.5
October	24.1	12.7	18.4	10.3

Harvesting for fibre production was carried out for each date of sowing at three intervals. The first harvest took place when there were 2—3 flowers per plant in bloom, the second when the plants were in full bloom and the third harvest was done when the colour of the lower capsules changed from green to yellow. At every harvest the plants were cut with a pair of scissors at ground surface and the cut plants were tied in bundles and weighed. The height of 10 representative plants taken at random at each replication was recorded. The leaves then were removed from the plants which were set in zink tanks filled with stagnant water for retting. Fifteen days later the retted stalks were washed to remove gum, then the retted fibres were stripped by hand and rewashed with clean water, dried in the sun and then weighed. All data were statistically analyzed to determine the significance of the difference between the mean values of the treatment.

Results

Table 1 shows the differentiation of flowering at each date of sowing in 1962 season. The plants of April 27 flowered on August 15 when they were 110 days old. On September 2 when they were 128 days old, the plants were in full bloom. On the plants of May 12 the first flowers opened on August 19 when the plants were 99 days old. On September 4 the plants were in full bloom and they were 115 days old. On August 23 the plants of May 27 began flowering and they were 88 days old. They were in full bloom on September 9 when they were 105 days old. No false sterile flowers appeared in that season.

Table 1

Staggering of the time of flowering during 1962 season

Date of planting	Date of opening the 1st flower	Appearance of the first flower after planting
April 27	August 15	110 days
May 12	August 19	99 days
May 27	August 23	88 days

Height of plants. The time of harvesting has affected significantly the height of the plants. The mean height of the plants at the first harvest was 164.9 cm, at the second harvest was 188.4 cm and at the last harvest the plants were 209.2 cm in height. The difference in height among the three harvests was highly significant (Table 2).

Table 2

Mean height of the plants in cm as influenced by the time of harvesting

Time of harvesting	Mean height of the plants cm
2—3 flowers in bloom	164.9
Full blooming stage	188.4
Maturity stage	209.2
L.S.D. 5% level	3.3

Green yield per acre. The mean weight of green stems has varied directly with the age of plants at harvest. Harvesting the plants at the maturity stage gave 46,200 kg per acre. Harvesting at the full blooming stage the yield was 41,300 kg per acre whereas the yield was 28,840 kg per acre when the plants were harvested at the opening of the first flower (Table 3).

Table 3

Green weight in kg as influenced by time of harvesting

Time of harvesting	Green yield in kg per acre
First harvest	28,840
Second harvest	41,300
Third harvest	46,200
L.S.D. 5% level	3150.00

Analysis of variance showed that the yields at the third harvest (maturity stage) and at second harvest (the full blooming stage) were more significant than that of the first harvest. The difference between the second harvest and the third harvest was also significant.

Fibre yield per acre. The mean yield of dry fibre has varied directly with the age of plants at harvest. At the first harvest the plants yielded 1338.20 kg of dry fibre per acre, at the second harvest the plants yielded 2304.40 kg of dry fibre per acre and at the last harvest the plants gave 2504.60 kg of dry fibre per acre (Table 4).

Statistical analysis showed that the yield of dry fibre at the last harvest was significantly higher than that at the second or at the first harvest. There was also a significant difference between the yield of the first and the second harvests.

Table 4

Mean fibre yield in kg per acre as influenced by time of harvesting

Time of harvesting	Mean fibre yield in kg per acre
2—3 flowers in bloom	1338.20
Full blooming stage	2304.40
Maturity stage	2504.60
L.S.D. 5% level	89.60

Discussion and Conclusions

The effect of time of harvesting on the yield of kenaf was only investigated in the season 1962. Both the green weight of the stalks and the dry fibre per acre tended to increase from the time of the first flowers appearance up to the stage of capsules maturity. This may be due to the continuous elongation of the

plants until the last date of harvest. The yield of dry fibre was significantly higher in the third harvest (at maturing stage) than in the first (at the beginning of flowering) and the second (full blooming). However FELIX (1957) had not found a significant difference between the yield of his last harvest (maturing stage) and the third harvest (full blooming stage). This might be due to the fact that FELIX had separated the bark from the stalks before retting. After the full blooming stage the bark became dry and could hardly be separated from the wood, so most of the inner fibre might have remained fixed to the wood of the stems.

Although quality tests have not been done on the samples of fibres, certain visual characteristics of the fibres have been noted. The fibre from plants harvested at the appearance of the first flowers were softer, brighter and more lustrous than those produced from the plants at the second and the third harvests, although the plants were much shorter. Fibres obtained from the plants at the second harvest were of good quality and taller than those of the first harvest but a little less silky and lustrous. Fibres obtained at the last harvests, although the tallest of all, they were dull, brown, harsh and very coarse. This might be due to the encrusting lignin over the fibre in the later stages of growth (BISWAS 1935) or to the increase of the secondary fibres in the stems on account of the primary fibres which are more glossy and flexible (ARNO—BORSCHTSCHOWA 1934 and CRANE 1947). It might be pointed out that the best time for harvesting kenaf occurs during the full blooming stage.

These results are in accordance with the afore-mentioned results by EVANS (1917), WALTERS (1920), Imperial Institute (1930) EL-KILANY (1939), ERGLE *et al.* (1945), DAVID (1948), KOCH (1948), GANSTAD *et al.* (1951), KOLBÉ (1952), SEALE *et al.* (1952) and FELIX (1957).

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CATALASE ACTIVITY OF THE SPEED AS AFFECTED BY ELECTRIC FIELDS

By

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The effect of homogeneous and inhomogeneous electric fields of static character on maize, pea and cucumber seeds is discussed. In the case of maize and pea seeds the effect was not uniform because the trend of the effect changed also as a function of the passing-through period. Catalase activity of cucumber seeds was increased by every treatment.

Introduction

Reviewing the literature of the effect of electric field on plants we find that beside experimental results showing economically significant stimulation frequently damaging effects are reported by research workers.

In the experiment of BURK—NELSON (1964) treatment of dormant seeds with radio frequency electric field resulted in physiological, morphological and genetic changes.

In the experiment of OSTAPENKO (1963) electric field treatment was favourable both for vitality and fertilizing capacity of the pollen.

The effect of electric fields on plants is explained by PIROVANO (1963) with the displacements of ions free or easy to release. According to MURR (1963, 1964) the effect may be connected with ionization. Accumulation of ionizable salts in a poisonous concentration ultimately leads to the dehydratation of the protoplasm. Further, by the stimulation of enzyme activity beside stimulating the normal metabolism also abnormal metabolic processes take place more rapidly. A third damaging effect may be the oxidation of enzyme molecules.

In the present paper we endeavour to contribute to the study of the question with our data concerning the effect on catalase enzyme activity of electric fields.

Materials and Method

Experiments were conducted with Mv 48 hybrid maize, pea and cucumber seeds treated by the aid of a laboratory equipment with homogeneous and inhomogeneous electric fields of static character and 3 and 5 kV/cm potential gradient. The passing through period was 5 sec and in the case of 5 kV/cm also 10 sec, respectively.

The electronics of our equipment was a high voltage supply unit functioning according to the impulse principle which could be adjusted from 1 to 30 kV. Its material transporting implement was a mechanically vibrated plate with adjustable number of strokes the inclination of which could be regulated without stages.

As in the seeds treated the catalase enzyme activity in dry condition had not changed as compared with the control, catalase activity of samples taken from the seeds cut into pieces was determined in 24 replications after 24 hours of soaking. Determination of enzyme activity was carried out with the gasometric proceeding and instrument of FRENYÓ (1962). To characterize the activity the volume expressed in cu.mm of oxygen released from 1 per cent hydrogen peroxide solution in 1 minute by the amount of enzyme in the sample examined is given. The mean of the data of 24 replications was completed with the standard deviation calculated on the basis of the formula

$$S = \pm \sqrt{\frac{\Sigma' V^2}{(n-1)}}$$

Results and Discussion

The effect of a homogeneous electric field of static character on maize, pea and cucumber seeds is presented in Table 1.

Table 1

Effect of electric fields

Treatment	cu.mm O_2/min		
	Maize	Peas	Cucumber
Control	148.0 ± 7.7	195.9 ± 18.6	189.6 ± 8.8
3 kV/cm 5 sec	125.6 ± 21.8	174.1 ± 16.5	221.0 ± 15.8
5 kV/cm 5 sec.	130.3 ± 16.0	178.6 ± 15.3	264.6 ± 19.2
5 kV/cm 10 sec.	176.1 ± 11.7	210.6 ± 14.0	358.7 ± 16.2

In maize and pea seeds the effect was of a uniform type. An electric field of 3 and 5 kV/cm potential gradient with a passing-through period of 5 sec considerably diminished enzyme activity as compared with the control. On the other hand 5 kV/cm electric field with double, 10 sec passing-through period strongly increased — in both plants — catalase enzyme activity.

In contrast to the two previous crops catalase activity of cucumber seeds was considerably increased by all treatments. The electric field of 5 kV/cm potential gradient with 10 sec passing-through period increased significantly catalase activity of the treated seeds also here, similarly to the case of maize and peas, as compared with the catalase activity of seeds that had obtained 5 sec treatment.

Table 2

Catalase activity

Treatment	cu.mm O_2/min		
	Maize	Peas	Cucumber
Control	148.0 ± 7.7	195.9 ± 18.6	189.6 ± 8
3 kV/cm 5 sec.	127.7 ± 13.7	193.5 ± 19.9	219.4 ± 11.7
5 kV/cm 5 sec.	130.0 ± 16.6	172.2 ± 20.6	226.2 ± 15.9
5 kV/cm 10 sec.	174.3 ± 16.2	207.2 ± 17.3	288.3 ± 13.0

The changes of catalase enzyme activity under the influence of inhomogeneous field is illustrated by Table 2; no essential difference was found between the effects of homogeneous and inhomogeneous fields.

From the data of the Tables it appears that the effect of an electric field on the catalase activity of seeds or, if enzyme activity is represented as physiological index of metabolism or biochemical processes, on biochemical processes preceding germination, is not uniform. The effect is seen to change also as a function of treatment and passing-through period applied. The data also point to the fact that enzyme activity of various plant species differently responds to the impact. This is explained with increased sensitivity of their metabolism.

Conclusions

Upon the influence of electric field a change occurred in the catalase activity of the treated seeds measured after 24 hours of soaking. The effect was not uniform in the seeds of the various plant species. In the case of cucumber seeds every treatment applied increased catalase enzyme activity. The degree of the effect and in maize and pea seeds also its trend depended on the passing-through period as well.

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THE COMPLEX QUALITATIVE INDEX OF WHEAT

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The planimetric area of a curve composed of the indices of ten factors of merit has been used to characterize all the qualities of winter wheat. The complex qualitative index thus derived characterizes the complete quality of the varieties with a single figure.

Introduction

In Hungary the quality of wheat varieties are judged in growing experiments by the values of farinographs, laborographs, the gluten test, Zeleny method and test baking. As it is generally known these methods do not characterize individually and certain the factors of merit. The experts agree that the full quality of the wheat can be represented only by several detail examinations and the proper emphasis of these data. The comparison of the qualities of wheat varieties is made difficult by the circumstance that each country uses its own methods for characterizing the different qualitative factors.

Both in Hungary and abroad attempts were made to find a better way of characterizing the quality of wheat by using factors of merit. SCHNELLER (1959) for instance calculated the baking value of wheat from the quantity of wet aleurone and from the expansiveness of the gluten with the aid of an empirical formula. BELDEROK — MEPPELINK — DE RUITER (1960) use the specific sedimentation value calculated from the ratio of the Zeleny value and protein for the same purpose. BROUWER (1962) holds that the qualitative value used earlier in Germany, which was calculated from the wet aleurone content, the rising values and the Zeleny value are inadequate for judging complex quality according to recent experience. In contrast to this view ROSENSTIEL—RUNDFELDT (1963) regard the complex selection index received from the same value as suitable for the same purpose. Since 1962 the Federal Republic of Germany has judged on the basis of BROUWER's (1962) opinion the quality of the varieties of official variety trials not by a quality index but according to the data of the Zeleny value, test value, crude protein content and test baking.

The different quality indices are calculated with the help of empirical formulae. ISENBECK — ROSENSTIEL (1950) for instance determine all the quality indices (die Gesamtgütezahl = GGZ) by multiplying the Testzahl by 50, the

Quellzahl by 100 and the wet aleurone content by 25, then adding up these products. The "baking wheat index" (Backweizenindex = BWI) of JAHN — DEESBACH — WEIPERT (1966) is calculated with the help of the following formula: crude protein content + 2.5 × the ratio of the sedimentation index and the crude protein of whole wheat. LEIN (1957), POKORNY — BECK (1958) pointed out that the size of the multipliers used in the formulae were disputable and needed to be modified. According to FAJERSSON (1964) even the results of the baking tests are alone insufficient for characterizing the complex quality.

The purpose of our present experiments is to work out such a complex quality index which alone can adequately characterize complex quality.

Material and Methods

In order to determine the complex quality index we used the material of the variety trials of Mesch held at Tápiószele in 1964. The plots of the varieties in machine sown experiments received two quintals of superphosphate, 1.3 quintals potassium salt and 1.7 quintals *Pétisó* artificial fertilizers per cadastral hold (0.57 ha). We used the values of ten quality testing methods for the characterization of the quality of the varieties. These are as follows:

1. The quantity of crude protein was determined by KOVÁCS according to the standard specification MNOSZ 6367—53.
2. The wet aleurone content was done according to GRUZL (1936) with gluten washing.
3. The Zeleny value was determined according to ZELENY's (1947) description.
4. The BELREDOK—MEPPELINK—DE RUITER (1960) process was used to determine the ability to hold gas in reference to 2 g of polished farina.
5. The farinographic values were determined by Brabender 's farinograph with a 50 g cup according to specification MNOSZ 6369—53.
6. The volume of bread was determined in water according to the method of BELDEROK *et al.* (1960) worked out for microbread, while test baking was done according to specification MNOSZ 6369—53.
7. Water absorption ability was determined with Brabender 's farinograph in reference to a 500 consistency line.
8. The ratio of bread form was determined according to MNOSZ 6369—53 standard specification.
9. The expansiveness of gluten was examined according to GRUZL (1936) after a rest of one hour.
10. The hull content was determined by the IBRÁNYI (1963) quick method.

Our several years of experimentation have proven that every index of the ten described properties clearly characterizes a particular factor of merit in the quality of wheat varieties. The higher values of the first seven qualities imply a better quality therefore in the figure their values were represented starting out from the centre with increasing graduation. On the other hand the increase of the ratio of bread form, the values of gluten expansiveness and hull content imply a lower quality (POLLHAMER 1965). Therefore the values of these properties were represented with decreasing graduation beginning at the centre of the figure and also with different colours. The planimetric area of the polygon gained when joining the values characterizes with a single complex quality index the complete quality of the variety. At the same time the figure well represents the dimension of the individual factors of quality and their interrelation. Thus in the formation of the size of the complex quality index, i.e., in that of the area of the polygon, every examined factor participates to a degree corresponding to its significance. Thus every possible methodological error falling upon the particular factors of merit is reduced by a multilateral examination.

Results and Discussion

The examined varieties were listed in the order of their qualitative values (Figs 1, 2, 3, and 4). The complex quality indices of the variants are from 159.9 to 19.6, thus the variation range of the varieties is great. According to this method of evaluation among the Soviet varieties the first is *Belocerkovskaja 198*, the second is *Bezostaja 1* and the third is *Mironovskaja 808*. The high complex quality indices of these varieties are not due to the outcome of the crude protein and wet aleurone quantity being the pertinent values medium, but mainly because of their better than average ability to hold gas, lower gluten expansiveness, good bread ratio form and small hull content. The *Bezostaja 1* variety which stands second with an index of 149.8 occupied approximately 50—55% of the growing area of winter wheat in Hungary in 1965. It deserves separate mention that among the examined 26 varieties its hull content was lowest.

A similar type was the *Udvaros 8/55* but its hull content was essentially greater than that of the former. Among the Hungarian varieties the *Bánkúti 1201* has a complex qualitative index of 109.9 and the *Fertődi 293* has an index of 106.5. Both varieties have a higher than average crude protein and wet aleurone content but their gas containing ability is relatively low, their bread form ratio and gluten expansiveness are high and their hull content is relatively high. The *Fertődi 293* variety is interesting for an additional reason: although its protein content is the highest of 26 varieties, its complex qualitative value is only medium. This proves that the quality of varieties cannot be judged merely on the basis of protein content.

The complex quality indices of *Branitzka Kolkunow*, *Etoile de Choisy*, *San Pastore* and *Jubilejna III* are the lowest. Generally speaking the values of the other qualitative factors of merit are also the lowest except in regard to protein content which is nearly of medium value, but the other qualitative values degrade the general quality of these varieties.

The data indicate that the complex quality of the individual varieties is based on different qualitative components. The curves of the best varieties approach a circle, thus almost all of their qualitative components are of higher than average value. Comparatively speaking a rather large number of varieties have too low an ability to hold gas, too high a gluten expansiveness and a high hull content.

With the aid of the complex quality value one figure is sufficient for adequately characterizing the complex quality of the varieties. The visual form of representation on the graph makes it simultaneously possible to numerically compare the individual factors and to examine their interrelation. Thus we can grasp the positive and negative factors of the quality of stock improving. With full knowledge of these, we can properly select — for improving quality — the adequate crossing partners and carry out the qualitative selection of generations

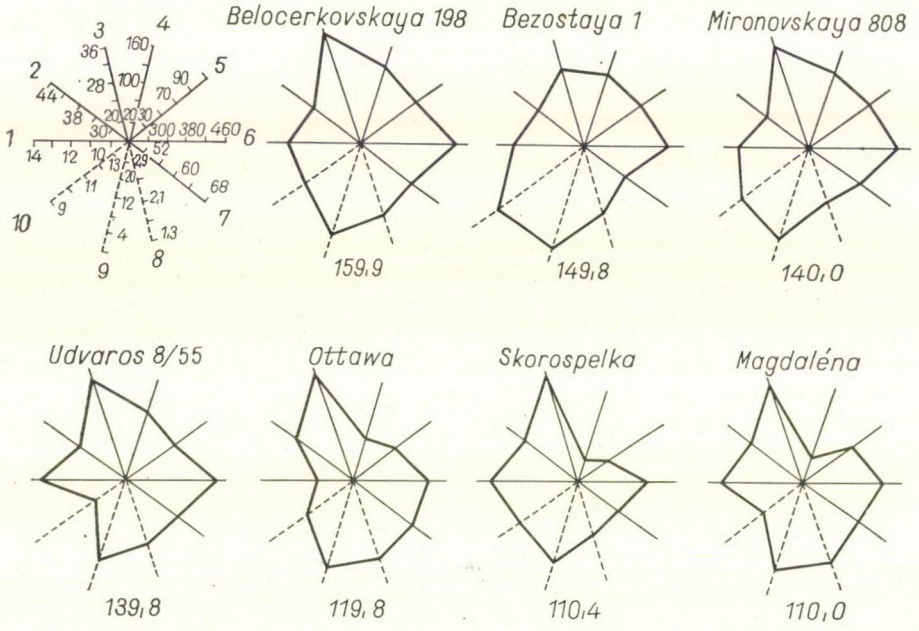

Fig. 1. Complex quality indices of winter wheat varieties. Martonvásár, 1965. 1. Crude protein, 2. Wet aleurone, 3. Zeleny value, 4. Ability to hold gas, 5. Farinographic value, 6. Bread volume, 7. Water absorption, 8. Ratio of bread form, 9. Expansiveness of gluten, 10. Hull content

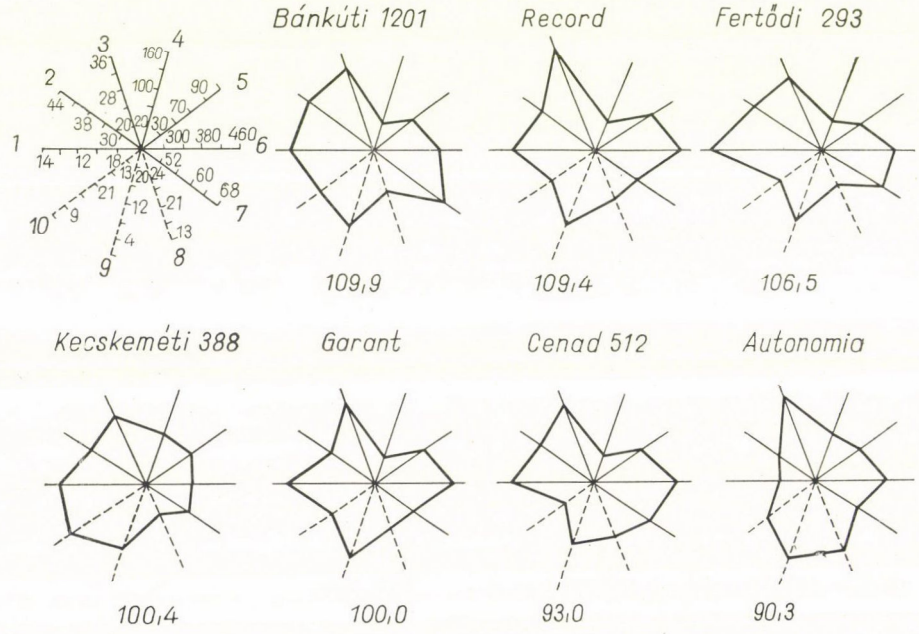

Fig. 2. Complex quality indices of winter wheat varieties. Martonvásár, 1965. See Figure 1

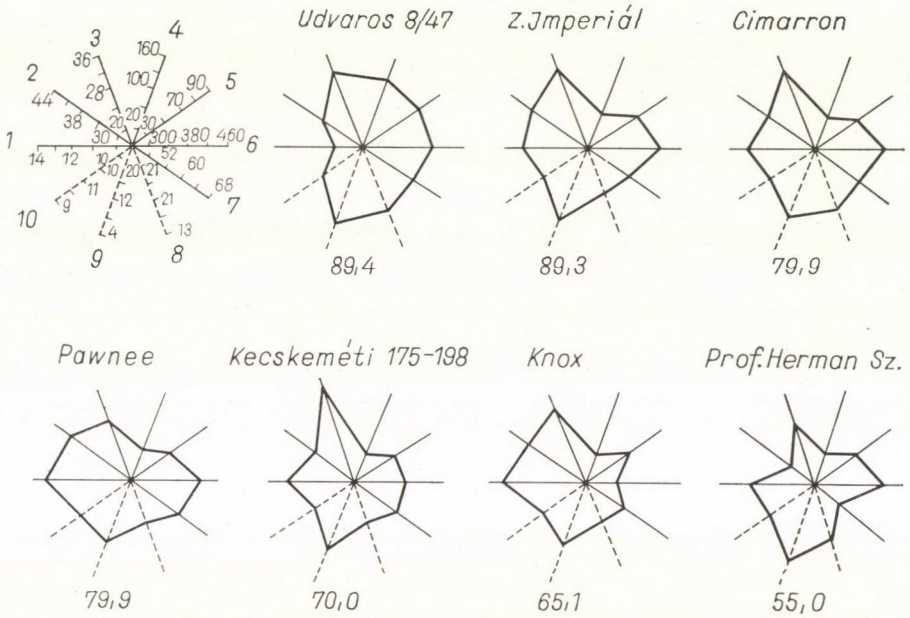

Fig. 3. Complex quality indices of winter wheat varieties. Martonvásár, 1965. The same as Fig. 1

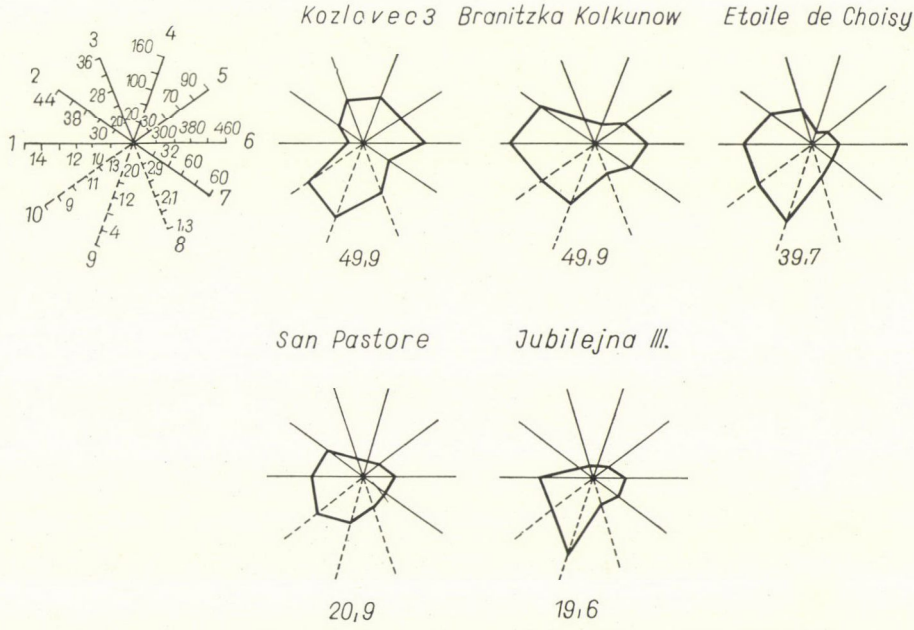

Fig. 4. Complex quality indices of winter wheat varieties. Martonvásár, 1965. The same as Fig. 1

of offspring. Furthermore the method is suitable for the examination of the different treatments on quality and for judging quality in case of agrotechnical experiments.

Conclusions

A planimetric area of a polygon based on crude protein, wet aleurone, Zeleny number, ability to hold gas, farinographic value, bread volume, ability to absorb water, ratio of bread form, gluten expansiveness and hull content has been used to represent the complex quality of 26 wheat varieties. The thus gained complex quality value well characterizes the over-all complex quality. The figures make possible the comparison of the different qualitative factors and the recognition of the relation among them. The complex quality value in our case ranges between 159.9 and 19.6 The method is equally suitable for determining the complex qualities of improving stock and the varieties of agrotechnical experiments.

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ONTOGENETIC STUDIES ON THE GROWTH AND DEVELOPMENT OF WESTERWOLDS RYEGRASS (LOLIUM MULTIFLORUM VAR. WESTERWOLDICUM, LAM.)

AS AFFECTED BY CUTTING TREATMENT WHEN GROWN ALONE UNDER FIELD CONDITIONS

By

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Uncut plants attained their maximum growth when inflorescenses tended to escape from their sheaths, and the rate of dry matter production was slow in the establishment period. Dry weight of leaves and stems was greatly reduced by cutting, and that of stubbles declined suddenly after cutting. Values of total dry weight of the plant after cutting were about one sixth of the maximum value given by the uncut plant.

Total productivity of the dry weight of leaves of the cut plants exceeded the dry matter production of leaves of the uncut plants, this was reversed in the stems. Application of cutting treatment for Westerwolds ryegrass generally lowered the total productivity of the whole plant when compared with the dry matter production of the uncut plant.

Introduction

Westerwolds ryegrass (*Lolium multiflorum* var. *Westerwoldicum* Lam.) is one of the most important pasture species known abroad. It has been recently introduced to the U. A. R. in an attempt to increase the forage yield of Egyptian clover and to improve its quality when both are used in a grass-legume mixture.

The effect of cutting treatments on the herbage yield of *Lolium* species and other grasses has been among the main points of investigation studied. ROBERTS—HUNT (1936) found that root growth of *Lolium perenne* and *Phleum pratense* was checked by all types of cutting and the amount of the check depended on the severity of cutting. The check of root growth was of three kinds: check in weight, check in actual growth, and seasonal check in growth rate. They indicated that shoot yield was seriously affected by varying the level at which cuts were made and by the frequency of cutting.

WEIMANN (1943), worked on Transvaal High-veld, reported that damage done to the plants by frequent defoliation was associated with corresponding reductions in the root-weights and depletion of root reserves.

MITCHELL (1954), worked on short-rotation and perennial ryegrass, found a reduction in the weight of tissue formed following defoliation which is primarily due to the decrease in quantity of photosynthetic tissue.

MITCHELL—COLES (1955) found that defoliation of short-rotation ryegrass, grown in full light, checked tillering a little but drastically reduced the quantity of tissue formed by individual tillers largely through reduction in size of the leaves being formed.

The scope of the present work was to study the dry matter production of Westerwolds ryegrass *(Lolium multiflorum* var. *Westerwoldicum*, Lam.) and its response to cutting treatment when grown alone under field conditions. This study will enclose some facts that might be important for studies dealing with interseeding this grass with Egyptian clover *(Trifolium alexandrinum)*.

Materials and Methods

This experiment was carried out at the end of November 1962 at the experimental farm of the Faculty of Agriculture Giza, U. A. R.

Seeds of commercial Westerwolds ryegrass *(Lolium multiflorum* var. *westerwoldicum*, Lam.) were used. Six plots, each measuring 6×7 meters were planted at the end of November 1962 at the rate of 24 lb/feddan. The experiment consisted of two treatments, cut and not cut. On December 30, 1962 a normal fertilizer of sodium nitrate (16 per cent N), and Calcium superphosphat (16 per cent P_2O_5) was broadcast in the experimental plots at the rate of 200 : 100 kg/feddan respectively. Other cultural practices were carried out in the usual way prevailing in the region. From 13th January, till 3rd of March, 1963 (the cutting date), samples of 10 plants were taken at random weekly from each of the six plots. On the cutting date, when the plants reached a height of about 80 cm, three plots were cut to three inches. On March 10, 1963, a week after cutting, samples of 30 plants were taken weekly from each treatment till the end of the experiment. Plants of each sample were separated into blades and stems. Spikes were added to stems when they became available. The component parts of the plants of each sample were then weighed after drying in an oven at 70°C for 48 hours and results were calculated in grams per plant.

Results and Discussion

A) *Dry weight of leaves.* Results concerning the effect of cutting on the average dry weight of leaves per plant are given in Table 1.

It is clear from the data obtained that dry weight of leaves of the uncut plants started to increase slowly till 17/2/63 and then increased steeply till it reached a peak of 1.4 gm/plant on 17/3/63. Dry weight then declined giving a value of 0.73 gm/plant on 14/4/63. This decline might be due to the high temperature prevailing at this period. Another peak (1.4 gm/plant) was then obtained in the next sampling date (flowering date). This was followed by a sharp decline till it reached zero at the end of the experiment, where leaves died out.

The dry weight of leaves was greatly reduced by cutting. It started to increase slowly to reach a maximum of 0.21 gm/plant against 1.4 gm/plant for the uncut plant. Dry weight then did not show any considerable change till 5/5/63 after which it declined steadily till the last sampling date where leaves died out. These results are in accord with those obtained by GRABER (1931), who indicated that reduction of dry matter of Poa pratensis occurred by cutting was due to reduction in photosynthetic organs of the plants. Similar approach

Table 1

Effect of cutting on the average dry weight (gm) of leaves, stems and whole plant of Westerwolds ryegrass in the successive sampling dates

Sampling dates	Average dry weight of leaves gm/plant		Average dry weight of stems gm/plant		Average total dry weight of the plant gm	
	Not cut	Cut	Not cut	Cut	Not cut	Cut
13/1/1963	0.10	—	0.05	—	0.15	—
20/1	0.23	—	0.12	—	0.35	—
27/1	0.22	—	0.12	—	0.34	—
3/2	0.35	—	0.20	—	0.55	—
10/2	0.35	—	0.23	—	0.58	—
17/2	0.33	—	0.26	—	0.59	—
24/2	1.00	—	0.83	—	1.83	—
3/3	1.25	0.00	1.55	0.93	2.80	0.93
10/3	1.30	0.07	1.55	0.32	2.85	0.39
17/3	1.40	0.21	2.20	0.36	3.60	0.57
24/3	1.00	0.20	1.90	0.57	2.90	0.77
31/3	0.68	0.21	1.42	0.39	2.10	0.60
7/4	0.85	0.20	1.90	0.35	2.75	0.55
14/4	0.73	0.12	2.58	0.30	3.31	0.42
21/4	1.40	0.17	3.00	0.40	4.40	0.57
28/4	0.50	0.15	2.90*	0.41	3.40	0.56
5/5	0.30	0.10	1.72	0.44*	2.02	0.54
12/5	0.26	0.05	1.88	0.40	2.14	0.45
19/5	0.00	0.00	2.49	0.49	2.49	0.49
26/5	0.00	0.00	1.38	0.48	1.38	0.48
2/6	0.00	0.00	1.17	0.44	1.17	0.44

* Weight of spikes was added to the dry weight of stems from this sample till the end of the experiment.

was reported by MITCHELL (1954), and MITCHELL—COLES (1955), on short-rotation ryegrass.

B) *Dry weight of stems.* Table 1 shows the effect of cutting on the dry weight of stems in gm/plant. It is clear from the data obtained that dry weight of stems of uncut plant inceased slowly in the establishment period of the plant reaching 0.33 gm/plant on 17/2/1963 (nearly 11 weeks after sowing). Dry weight then increased sharply giving a value of 2.20 gm on the middle of March. High temperature occurred after this sampling date, reduced dry weight of stems to 1.42 gm/plant at the end of March. Dry weight then recovered to reach a maximum value of 3.0 gm/plant on the flowering date (21/4/63). Thereafter, dry weight declined to 1.72 gm; two weeks after flowering. This decline might

be attributed to the effect of flowering which consumed food reserves of the plants. LOEHWING (1940) has worked on hemp, beans, and other herbaceous plants and has indicated that mobilization of reserves begins with flower formation rather than with fruiting. This is apparently a preparation for the immediate and large respiratory demands of flowering itself as well as for the heavier nutrient demands of fruit enlargement. The same author also found that high rates of respiration during the flowering phase temporarily depleted carbohydrate reserves.

The decline noticed after flowering was followed by an increase reaching another peak of 2.49 gm/plant on 19/5/63 where grains were nearly fully developed by this date. This increase in the dry weight of stems (plus spikes) was associated with a corresponding decrease in dry weight of leaves which tended to die out during the same period. Such observation might be due to a translocation of various constituents from leaves to stems where they were utilized mainly by the developing seeds. Similar approach was reported by AYRES (1936), who found that dry matter of dead cane leaves was found to contain much lower concentration of nutrients (K and P) than that of green leaves. He concluded that these nutrients had migrated from the leaves back to the stalk before the leaves became physiologically inactive.

From the May 19, 1963 onwards the dry weight of stems dropped till the end of experiment as plant tended to die out and the seeds were easily shattered (HUGHES *et al.* 1953). Cutting reduced dry weight of stubble from 0.93 gm to 0.32 gm/plant a week after cutting; one fifth as much as that of the uncut plant (1.55 gm) on the same date. This drop is interesting since it showed that the stored food material decreased owing to its utilization in the formation of new tissues as well as in respiration. Moreover, this might also indicate that the rate of food reserves consumption exceeded to a great extent the rate of those brought from the photosynthetic activity of the negligible leaf area left after cutting. After this drop dry weight then recovered reaching a maximum of 0.57 gm/plant on 24/3/63 against 1.9 gm for the uncut plant on the same date. Thereafter, dry weight declined slowly reaching a minimum of 0.30 gm in the middle of April 1963, and then did not show any considerable change till the end of the experiment. The flowering of the cut plants which started a week later was very weak when compared with that of the uncut plants, and hence did not show any effect on the dry weight of the stems of the treated plants.

C) *Total dry weight of the plant.* It is shown from the data concerning the effect of cutting on the total dry weight of Westerwolds ryegrass plant (Table 1) that the trend of the total dry weight of the whole plant was the resultant of the behaviour of its component parts. The dry weight of the uncut plant started to increase gradually but slowly during the establishment period till the 17th of Febr. 1963 where value was 0.59 gm/plant. Dry weight then increased steeply to reach a peak of 3.60 gm a month later (17/3/63). The value of total dry weight

then declined sharply, due to high temperature prevailing at that time to reach 2.10 gm/plant at the end of March. In the following three sampling dates, total dry weight recovered showing a sudden increase reaching a maximum of 4.40 gm/plant on the flowering date (21/4/63). This indicated that Westerwolds ryegrass plant attained its maximum growth when inflorescences tended to escape from their sheaths. Similar conclusion has been arrived at by STAPLEDON (1924), in his work on the seasonal productivity of some herbage grasses.

Within the fortnight after flowering the dry weight of the whole plant declined sharply to reach 2.02 gm on 5/5/63. This decline might be attributed to the sequence of physiological events which accompanies flowering or anthesis. In this respect the findings of LOEHWING (1940, 1953) indicated that flowering was accompanied by a high rate of respiration which temporarily depleted carbohydrate reserves. Moreover, plants by this stage show apparent reduction in absorption by roots and an internal shift in water balance followed in turn by altered translocation and redistribution of nutrients. From 5/5/63 the dry weight of the whole plant increased to reach 2.49 gm/plant on 19/5/65 where seeds were nearly fully developed by this date. Thereafter, dry weight declined sharply till the end of the experiment as plant tended to die out and seeds were easily shattered (HUGHES, *et al.* 1953).

Cutting has greatly reduced the total dry weight of the plant. A week after cutting value dropped to 0.39 gm against 2.85 gm in the uncut plant. This drop was explained and discussed before in the results of the dry weight of the stems. Total dry weight was then recovered increasing to reach a maximum of 0.77 gm on 24/3/63; about one forth as much as that given by the non treated plant on the same date. Thereafter dry weight declined to 0.42 gm at the middle of April, increased slightly in the next sample to reach 0.57 gm against 4.40 g, for the uncut plant. Values then did not show any considerable change till the end of the experiment.

Results of like character were reported by WEIMANN (1943) in his work on transvaal High-veld, who indicated that frequent defoliation resulted in simultaneous decline in the herbage yield and consequent reduction in the total yields of nutrients in the herbage per unit area.

D) *Total productivity of the cut plant.* The total productivity of the dry matter of leaves, stems, and the whole plant of the cut treatment in comparison with the dry weights given by the uncut plant is shown in Table 2. The different components of the cut foliage (leaves and stems) have been separated and weighed dried. These weights have then been added to the dry weight of leaves and stems produced by the cut plant on the successive sampling dates.

It is clear from the general trend of the total productivity of dry matter of the component parts of the cut plant that while total productivity of the leaves exceeded that of the dry matter production of leaves of the uncut plant, this was reversed in the stems. This might be due to: (1) utilization of a good

Table 2

Average total productivity of dry matter of the component parts of the cut plant of Westerwolds ryegrass compared with the corresponding dry weights given by the uncut plant*

Sampling dates	Average dry weight of leaves gm/plant		Average dry weight of stems gm/plant		Average total dry weight of the plant gm	
	Not cut	cut (T. p.)	Not cut	cut (T. p.)	Not cut	cut (T. p.)
10/3/63	1.30	1.32	1.55	0.94	2.85	2.26
17/3	1.40	1.46	2.20	0.98	3.60	2.44
24/3	1.00	1.45	1.90	1.19	2.90	2.64
31/3	0.68	1.46	1.42	1.01	2.10	2.47
7/4	0.85	1.45	1.90	0.97	2.75	2.42
14/4	0.73	1.37	2.58	0.92	3.31	2.29
21/4	1.40	1.42	3.00	1.02	4.40	2.44
28/4	0.50	1.40	2.90**	1.03	3.40	2.43
5/5	0.30	1.35	1.72	1.06**	2.02	2.41
12/5	0.26	1.30	1.88	1.02	2.14	2.32
19/5	0.00	1.25	2.49	1.11	2.49	2.36
26/5	0.00	1.25	1.38	1.10	1.38	2.35
2/6	0.00	1.25	1.17	1.06	1.17	2.31

* Average initial dry weight of the cut foliage = 1.87 gm/plant (leaves 1.25, stems 0.62 gm/plant).

** Dry weight of spikes was added to the dry weight of stems from this sample till the end of the experiment.

deal of food reserves of the stubble a week after cutting in building up new photosynthetic tissues as well as in respiration. (2) The initial weight of leaves obtained from the cut foliage of the plant was nearly twice as much as that given by their stems, and (3) the dry weight of leaves of the uncut plant did not show any considerable increase after 3/3/1963 (cutting date) while that of their stems was nearly doubled in the later stages of growth.

The trend of the total productivity of dry matter of the whole plant in the cut treatment was the resultant of the behaviour of its component parts. This total productivity was generally reduced when compared with the dry matter production of the uncut plant. Values of the former did not exceed 2.64 gm/plant against a maximum of 4.40 gm reached by the uncut plant. Thus, it may be concluded that application of cutting treatment for Westerwolds ryegrass has generally tended to lower the total productivity of dry matter of the plant.

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A NEW DAMAGE CAUSED TO MAIZE BY OSCINELLA FRIT L. AND ELACHIPTERA CORNUTA FALL.

By

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A damage unknown up to now, stem rot caused by *Oscinella frit* and *Elachiptera cornuta* Fall. has appeared on maize.

According to our examinations *E. cornuta* is a secondary pest of maize infecting only damaged plants. Effective damage observed on plants infected to 15 per cent on the average is economically insignificant. In lines and hybrids susceptible to frit fly the secondary damage done by *E. cornuta* Fall. deserves attention.

Introduction

On August 13, 1965, a rapidly spreading disease unknown to the agronomists was reported to the Agricultural Research Institute in Martonvásár by the Cooperative Farm "Petőfi" in Nagykorpád.

Visiting the spot immediately we established after thorough investigation that the damage was not of fungal origin but due to some sort of insect. In 1965 a similar damage was observed by N. Hoffman in Mezőhegyes and J. Bozai in Kenderes (verbal communication).

Jermy (1960) was the first to report on damage by frit fly on young maize plant while Dolinka—Manninger (1962) reported on combined damage by frit fly and maize smut and on resistance of lines and hybrids to frit fly. The damage by the frit fly occurring repeatedly year by year made it necessary to extend research work on resistance as a result of which at present we are better informed on the possibilities of controlling the pest. The same cannot be stated so unequivocally on *E. cornuta* on the biology and ecology of which as well as on its economic significance not only few literary data are available but the existing ones are rather contradictory. It has not been elucidated so far whether the species in question is damaging primarily or secondarily. Therefore it is important to summarize opinions concerning this subject.

The first relevant data were supplied by Kreiter (1927) who regarded *E. cornuta* as a primary pest of cereals, in the first place of barley. According to Balachowsky—Mesnil (1936) it causes damages only secondarily, when the plant has already been infected by frit fly. Ney (1959) ranges *E. cornuta* to the saprophagous insects living on rotting plants, i.e. he does not consider it as a pest at all.

Damage done by *E. cornuta* on maize is mentioned for the first time by SAPIRO (1958) who characterizes the insect as a secondary pest. According to CHZHAO DZJANY-MIN (1958) *E. cornuta* is, however, one of the most important pests of maize which together with the other species of corn flies may cause a damage amounting to 90 per cent in maize. Similar opinion is professed by TRASEVICH (1958) stating that the damage of *E. cornuta* is similar to that of

Fig. 1. After the secondary infection of the *E. cornuta* Fall. larva the apical leaves of the maize turn brown. Photo: Zs. Ludván

the frit fly. Observations and experiments of VILKOVA (1962) demonstrate that *E. cornuta* is a secondary pest of cereals, maize and other crops which only infects plants already damaged and beginning to rot and therefore may be considered as saprophagous.

Material and Method

The hybrid maize Mv 48 sown in 1965 in the cooperative farm of Nagykorpád was strongly infected in the spring by frit fly. Later most plants overcame the infection. In the end of summer, however, *E. cornuta* on 15—20 per cent of the stand deposited its eggs on the scars caused by the frit fly. As a consequence of the damage done by the developing eggs or larvae the apical leaves of the plant turned brown (Fig. 1). Above the ear primordium at the first node the maize broke in 4—5 days (Fig. 2) and fell on the earth. The soil from the many leaf and tassel primordia offered a picture seen when the maize is headed (Fig. 3). Although on the infected plants the female inflorescence was of normal development one third of the assimilation surface

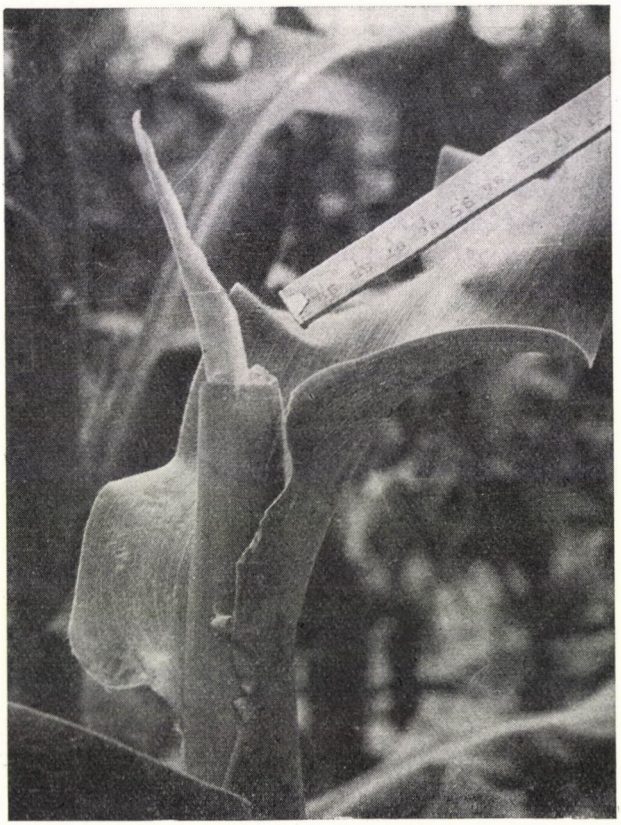

Fig. 2. At the site of the infection the stalk breaks off while the female inflorescence remains intact. Photo: Zs. Ludván

decayed. Above the ear primordium the internode began to rot in all infected plants and 5—35 worms and pupae were found in it. Most of the larvae were in the liquefied tissues while the pupae in the part between the dry stalk and the leaf sheath. Our findings were corroborated by the related observations of NILKOVA (1962).

A great amount on infected plants were brought into the laboratory to determine the species.

In order to establish the damage ears were broken from 40 infected and 40 healthy plants of the area in question after maturation and elaborated in the laboratory. Raw corn on the cob, dried and kernel yield, shelling ratio, moisture per cent and ear length were determined. Taking into account a 15 per cent average infection the effective damage was calculated.

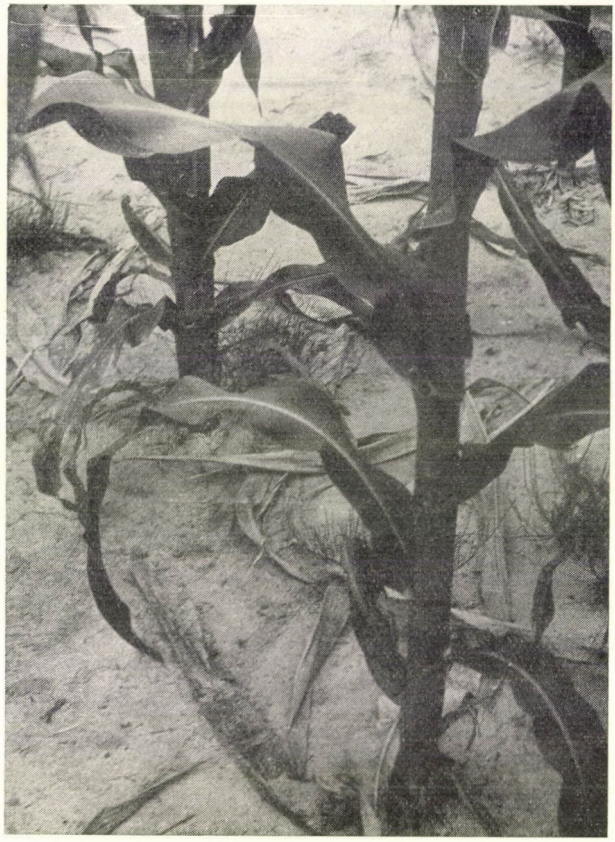

Fig. 3. In a few days the wilted stalk falls on the earth. Photo: Zs. Ludván

Results and Discussion

The swarmed out flies proved to belong to two species: *Elachiptera cornuta* Fall. a great amount of which occurred in the material while the other, *Oscinella frit* L. played a rather inferior part. Such phenomena, viz. the combined occurrence and damage of the two insects have been unknown up to now in Hungary.

E. cornuta can be found everywhere in our fauna area. Detailed data on its spreading were published by DRASKOVITS (1964). Its swarming period was established from the material of the Natural History Museum. The data of collection are presented in a column diagram system (Fig. 4) where the specimens under the same data of collection from various provenances count for a unique data.

On the basis of the diagram *E. cornuta* appears to have probably several generations. From the comparatively few data available we cannot yet con-

clude the number of generations although the species in question is — as verified by the diagram — in the air throughout the whole year and the peak of its swarming is in April-May. Damage done by *Oscinella frit* and *Elachiptera cornuta* is represented in Table 1.

From the Table it appears that the pest caused 14 per cent damage in the raw corn on the cob and 11.67 per cent in dry kernel yield. On the diseased plants the ears were generally smaller and some premature ripening occurred which was also shown by the lower moisture per cent at snapping. Damage must have been caused in the first place by the 1/3 assimilation surface destroy-

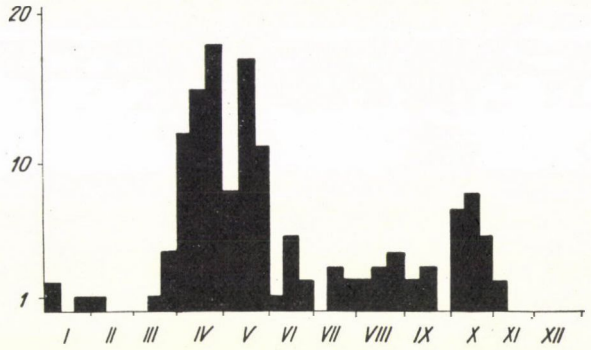

Fig. 4. The developments of the flying of *Elachiptera cornuta* Fall. in annual distribution. (On the horizontal axis the time is represented in a grouping per ten days while on the vertical axis the number of the proveniences)

Table 1

Developments of the damage by Oscinella frit L. and Elachiptera cornuta Fall. on maize in the cooperative farm "Petőfi" of Nagykorpád in 1965

Yield analysis of hybrid Mv 48	Healthy plant	Infected plant	Damage %	Effective loss of yield in %*
Raw corn on the cob kg	0.243 ± 0.050	0.209 ± 0.04	14.00	2.10
Dry (14.5% moist. cont.) yield of corn on the cob kg	0.143 ± 0.020	0.127 ± 0.030	11.19	1.68
Shelled corn of 14.5 per cent moisture content kg	0.120 ± 0.020	0.106 ± 0.030	11.67	1.76
Corn to cob ratio, per cent	83.36 : 16.64	83.04 : 16.96		
Moisture content at snapping, per cent	41.16	39.24		
Ear length cm	17.2 ± 3.0	16.4 ± 3.7		

* On the basis of 15 per cent average incidence.

ed before flowering, since it can be assumed that pollination would not have failed to occur even with 50—60 per cent infection because 30—40 per cent healthy male flowers produce enough pollen to fertilize the female inflorescence of the whole stand. In this respect well known data are available from hybrid maize seed production where the maternal rows amounting to 2/3 are artificially detasseled and the tassels of the 1/3 paternal rows result in satisfactory pollination and normal yield. In Mezőhegyes *E. cornuta* has infected the susceptible M 14 line secondarily to 90 per cent. Here the sound tassels developed on 10 per cent of the stand did no more secure enough pollen for pollination. (Verbal communication of HOFFMAN.)

The above data verify that the effective 1.76 per cent damage of *E. cornuta* on maize, is insignificant and occurs only if on the plant a so-called primary parasite, such as the frit fly referred to, has previously appeared. In the susceptible lines and hybrids, however, the secondary damage by *E. cornuta* does deserve attention.

Conclusions

In 1965 in Nagykorpád, Kenderes and Mezőhegyes a new damage appeared on the maize plant which had been caused by *Oscinella frit* L. and *Elachiptera cornuta* Fall.

In Hungary, on young maize frit fly infection has regularly occurred since 1959, which has, however, been more or less overcome by the hybrids.

Damage of *E. cornuta* occurred on the maize individuals that had already been previously infected by the frit fly. It is characteristic of the damage caused by the latter that the apical leaves wilt and turn brown before tassel emergence (Fig. 1). Above the ear, at the first node the stalk rots off and falls on the earth (Fig. 3). In spite of that the female inflorescence of infected plants normally develops and if enough pollen is available, fertilization takes place, and an economically insignificant loss in yield arises (Table 1).

On the basis of the facts referred to we consider *E. cornuta* Fall. as a secondary parasite. Its damage has a serious economic importance only under cool and rainy environmental conditions favourable for frit fly and other parasitic or pathogenic agents on susceptible maize varieties.

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COMPARATIVE EXAMINATION OF METHODS DETERMINING CATALASE ENZYME ACTIVITY

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By way of permanganate titrating, the gasometric method of FRENYÓ and with the *Scheibler* device we have determined, manometrically, the catalase enzyme activity in the leaves of apple varieties during vegetation. The three methods examined by us are suitable for measuring catalase activity change and might provide us with data concerning individual development and metabolism. We suggest the gasometric method of FRENYÓ for field measurements, because of its simpleness and as to the performance of reaction, it is more accurate than the two other methods. While working, the released oxygen volume which is brought about by the continuous decomposition of peroxide during reaction, can be read directly and the enzyme activity is easy to determine from a relatively small sample. The manometric determination of catalase activity performed by way of permanganate titrating method and with the *Scheibler* device, is suggested to be applied in laboratory.

Introduction

Agricultural technics of horticultural production can also be developed by way of being well acquainted with the physiological properties of plants adapting to the latter the methods of production technics. Merely by agrotechnical methods, without physiological knowledge, productivity can but little be increased.

Thus, practice must sense the aid of theory by way of characteristic indices. Suitable theoretical indices might be some enzymes, too, since — being parts of metabolism — the changes in their activity might indicate whether the applied agrotechnology is advantageous or disadvantageous for the metabolism of the plant or fruit tree, respectively.

According to BARTEL (1964) the catalase enzyme examinations are suitable for giving early information on certain properties of ligneous plants. This concept is in good agreement with KOBEL's opinion (1957). "The well-known physiological phenomena and regularities will aid fruit grower experts of understanding the symptoms of life in fruit-trees. That will enable them to choose the right cultivation method applied at proper time, and by doing so they might help and improve the life of fruit trees."

For the determination of catalase enzyme, several methods have been elaborated; the summary of some of these is described herein. FELFÖLDY (1957) measures the catalase activity with the improved permanganometric

method. He calls the attention to the fact that in his method the catalase activity differs in the leaves of different age, to such an extent that one cannot use the same degree of dilution.

Instead of the permanganometric methods DRBOGLAV (1957) prefers the iodometric method. In his work published in 1959, he criticizes the methods used until now for catalase determination. Then he gives an expounding of the improved iodometric method of his which being too lengthy cannot be dealt with here. KINZEL (1959) has determined the catalase activity volumetrically at 18—20° C, in the presence of 30 ml phosphate buffer (pH 7.4 and 50 ml 1% H_2O_2 for 200 g wet leaf-weight).

A new and appropriate catalase determination method has been submitted by GAGNON (1959) the point of which is that a proper filter paper disc impregnated with a catalase containing pressliquid, is placed at the bottom of the vessel filled with hydrogen peroxide solution. The lifting power of the oxygen released, lifts the filter-paper disc to the surface of the vessel. The time needed for the paper disc being lifted to the surface is registered. Linear calibration curve is obtained by representing the logarithm of time against enzyme activity. We want to point out, however, that of the respective literature we must be content with giving only the most necessary ones. We are also aware of the fact that in the meantime some methods have been improved, altered or used in several variations.

Materials and Method

Catalase activity measurements were made with three methods during vegetation, beginning on May 25 and being repeated on 13 occasions up to October 12 with two year-old *EM IV.* apple rootstock and own root *Starking* variety. In general, samplings were made every 10—13 days.

In our experiments we have examined the catalase activity of the foliage leaf samples. The reason why leaf samples had been chosen was that leaves were easily accessible for sampling.

For measurings leaf sample was always taken in the morning at 6.30 a. m. in Soroksár. The comparative measurings of methods have been performed at the Chair of Nursery Gardens at the College of Horticulture and Viticulture on the days of examination, always between 9 a. m. to 2 p. m. The leaf samples gathered at 6.30 a. m., have been put into a polyethylene plastic-bag and cooling satchel then brought in the laboratory for being examined. In the case of the Frenyó—Scheibler methods measurements have been made in 5—5 repetitions per each leaf-level while with the permanganate titrating method 3 repetitions have been made at each leaf-level. (One repetition with five titrating parallels.) On the next day examinations have been made similarly, always with the other variety (own root *Starking).*

Of the methods known from literature we have selected the following ones taking into consideration the devices, work-requirements and reaction time, — in order to choose, on the basis of the results, those most suitable for measurements on the field.

1. Permanganate titrating method

After Bach-Oparin (cit: BELOSERSKI—PROSKURJAKOV 1956) this has been applied with following alteration:

2 g of leaves have been ground with 20 ml distilled water and then centrifuged. After centrifuging the supernatant i.e. the leaf extraction was poured in a clean, empty test-tube. After this we measured 5 ml distilled water into another empty flask and then 1.5 ml 1 per cent

H_2O_2 solution. Thereafter 2 ml of the leaf-extract was added. Exactly at that time, the stopper clock was started and time was checked every second; when 5 minutes had elapsed 2.5 ml 10 per cent H_2SO_4 was added. The mixture thus obtained was titrated for 30 sec. with 0.1 *n*. $KMnO_4$ up to the remaining pink, and then the decreased $KMnO_4$ was read in ml. When examining the control, we acted as before with the exception that the 2 ml were taken from the leaf-extraction that had previously been boiled for 30 minutes and thus killed off. While examining each variety, we have performed three repetitions at each leaf-level of a single shoot of trees and five titration parallels at each repetition.

2. Manometric determination with the aid of the Scheibler-device
(FRENYÓ-SZALAI 1962)

From the leaf to be examined we have measured 1 g and rubbed it to a fine pulp with a small amount of quartz sand and 20 ml distilled water. In the device water-level was adjusted to O and the exit taps were closed. To the rubbed material 5 ml of 1 per cent H_2O_2 was pipetted; simultaneously we started the stopper clock and began to shake the vessel in a manner that the rubbed material should get well mixed with the peroxide. The catalase enzyme decomposes the peroxide and the developing quantity of O_2 is read on the manometer in ml every minute. The measuring has been continued for 5 minutes with five repetitions at each leaf-level, of a single shoot of trees.

3. Gasometric method
(FRENYÓ 1962)

By way of the gasometric method and device, respectively, according to the Hungarian Patent FE-542 the catalase enzyme activity can be measured quickly and accurately not only under laboratory conditions but also in the field, in the nearest vicinity of plants. The device consists of two parts: the recipient of a volume of about 3 ml; one end is ground and on one side a small widening-out is visible. Here will the small sample be placed. The other part of the device is a calibrated glass-tube with an inner diameter of 2 mm one end of which is ground. Into the recipient 1.5 ml of 1 per cent H_2O_2 will be poured drop by drop with a dropper. In the protruding part of this device a leaf-sample with statistically identifical surface had been placed. Enzyme activity is displayed by the scar-surface of the disc cut out from the leaf. When the sample and the reagent meet, we start the stopper clock and, through mild shaking, there begins the decomposition of peroxide. With the volume-expansion of oxygen gas being gradually released, the 1% H_2O_2 i.e. the reagent liquid-surplus is pressed into the measuring tube and is moved downwards in a liquid column getting longer and longer corresponding to the prevailing peroxide decomposition. The constant of the process has been calculated according to the following formula: $K = \frac{1}{t}\ 10\ g\ \frac{x_1}{x_2}$ where "t" stands for the minutes, x_1 and x_2 the volumes read at the beginning and at the end of "t" time. In our experiments, however, that calculation has not been applied as — in our opinion — the activity of the examined samples can be well expressed and characterized through the volume of oxygen getting free during 1 minute in cu. millimeter. With that method we want to call the attention to the way of sampling. A leaf-sample of determined disc-number and scar-surface is always to be applied, otherwise the spreading of data will increase.

Results and Discussion

In evaluating the methods, the graphical representation proved to be the best, i.e. on the graph the examined data differ from one another visibly. The comparison of the methods is shown at the middle leaf-level with both the *EM IV* apple material and the *Starking* variety with own root. Our choice fell on the middle leaf-level because it is here that the change of catalase activity is the most balanced and the most uniform in the course of vegetation. It has seemed also advisable to apply the method of taking the average of the lower, middle and upper leaf-levels and this being illustrated with each methods.

This, however, we have not found proper since the leaves of the upper and lower leaf-levels are, in certain stages of vegetation, more active and their averaging would not reflect the changes of the real activity; a fact that, due to the sensitiveness of the methods, would be disadvantageous.

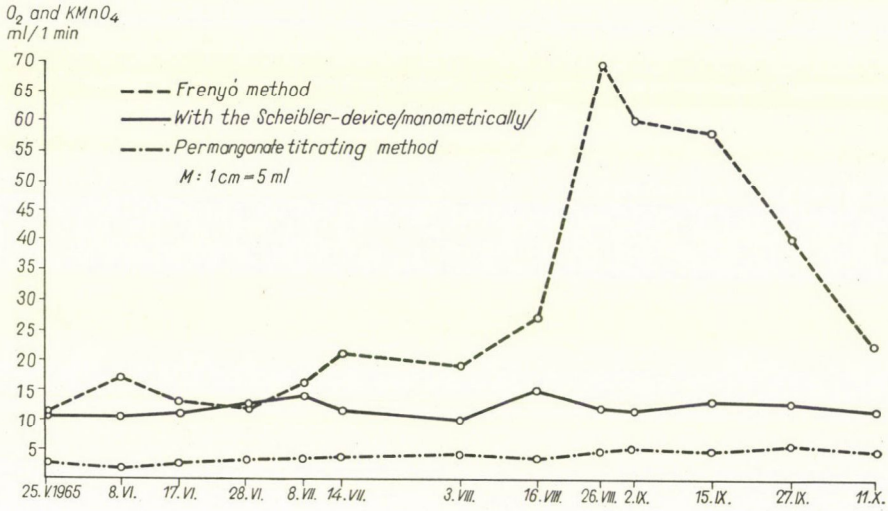

Fig. 1. Catalase activity of EM IV apple-rootstock (middle leaf-level)

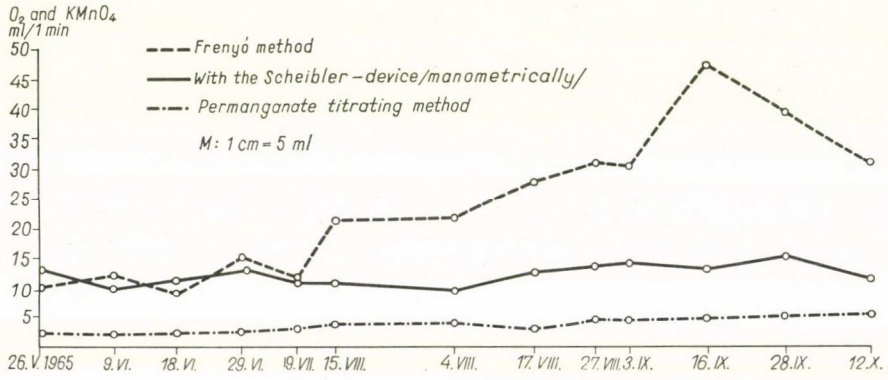

Fig. 2. Catalase activity of the own root Starking apple variety (middle leaf-level)

With the comparative examinations performed on 13 occasions in the course of the vegetation the measurements made with FRENYÓ's method and those carried out with the titrating method, were, in principle, in good agreement, however, in tendency they differed in certain cases of points of time which, most probably, has been brought about by the different sensibility of the methods and the different states of ripeness in the foliage leaves.

The manometrically performed measuring on June 28 with the apple-material *EM IV* differs, in tendency, from FRENYÓ's method this being due to the individual development and metabolism of *EM IV*, since along with ageing of leaves these differences cease to exist in the case of all three methods.

With the *Starking* apple variety having own root, there is difference in tendency with the three methods in the period May—June when growth is intensive. There is also a difference at the end of vegetation because growth and development have not yet finished and defoliation has also begun at that time.

Conclusions

DRBOGLAV had reflected on the methods determining catalase enzyme activity as early as in 1959, and instead of the permanganate titrating method he thinks the improved iodometric method more suitable. According to our experiments all the three methods compared by us, can be well used and are suitable for determining the catalase enzyme activity.

All the three methods show in a sensitive manner the change of catalase activity in the course of the vegetative period. The highest grade of sensitivity is shown by FRENYÓ's method.

Here are some comments on the field-application of FRENYÓ's method. Care has to be taken not to make measurings on a hot day in strong light but rather in shadow corresponding to characteristic daily temperatures. The 1 per cent hydrogenperoxide has always to be prepared right before measuring and the measuring tool should be kept clean. On the occasion of sampling the number of leaf-discs should be always definite, the scar-surface of which will also be relatively the same.

The permanganate titrating method is more complicated, its reaction time is longer requiring more labour and equipment, than the method of FRENYÓ. The material of the sample is leaf-homogenisate. Its application is advised for laboratory measurements.

The manometric determination of catalase activity with the *Scheibler*-device is relatively simple, however, it is of high labour intensity. (The rubbing of leaves into homogenisate.) The time of reaction agrees with that of the permanganate titrating method. Care must be taken that the system should be closed from start to finish during measuring.

Acknowledgement

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ADDITIONAL DATA TO THE HUMUS-DECOMPOSING ACTIVITY OF SOME ACTINOMYCES AND MICROSCOPICAL FUNGI

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Without a complementary carbon source the microscopical fungi included in the experiment are not able to utilize the Na-humate brought to the nutrient solution while the overwhelming majority of the 22 examined Actinomyces strains shows satisfactory growth under such conditions and is able to decompose a remarkable amount of Na-humate. In the presence of complementary carbon sources (glucose, cellulose) a considerable part of the microscopical fungi are able to attack the Na-humate but the amount of humus decomposed by the Actinomyces also considerably increases. The combined application of complementary carbon and nitrogen sources promotes the mineralization of the Na-humate only in the case of certain Actinomyces while in the case of fungi it does not show that effect at all, on the contrary, it even reduces the amount of the humus decomposed. On the basis of the above it may be assumed that a considerable part of the examined microorganisms — in the first place the microscopical fungi — is able to attack the nitrogen-containing side chains of the humus compounds provided the substrate contains a readily utilizable carbon source.

Introduction

From literary data [Nikitinsky (1902), Hoppe-Seyler (1899), Waksman (1937), Lynch—Lynch (1958) and others] it is well known that the humus substances of the soil are exceedingly resistant to the mineralizing activity of the microorganisms. Vinogradsky assumed the existence of a specific (autochtonous) microflora in the soil, the members of which nourish themselves with humus. Later examinations, however, proved that no such specific microflora existed but as to the proper place of the humus substances no unequivocal statements are found in literature. According to Pontovitch (1938) some bacteria decompose not only the compounds with open carbon chain but are able to attack also the compounds of cyclic structure. Mishustin—Nikitin (1961) report that the *Pseudomonas* sp. examined by them are able to mineralize much more humus than the *Bac. mesentericus* or a Penicillium or an Actinomyces strain. Didier de Saint Amand (1956) stresses in addition to bacteria the importance of Actinomyces beside bacteria in the decomposition of humus substances. The role of Actinomyces in the decomposition of humus substances is also underlined by Kononova (1952) while Küster (1950) and Tepper (1949) attribute primary importance to the *Nocardia* (Proactinomyces).

The intensity of the mineralization of humus substances is influenced by

a very great amount of factors. The examinations point to the fact that the decomposition of the humus preparations extracted chemically from the soil under laboratory conditions greatly depends on the chemical composition of the culture medium. WEBLEY—KORK (1952), MISHUSTIN—NIKITIN (1961) FEDOROV—ILYINA (1961), VOLKOVA (1961) and other authors publish data according to which the addition of complementary carbon and nitrogen sources readily utilizable by microorganisms to the humus-containing culture medium also promotes decomposition of humus compounds difficult to mineralize.

Material and Method

In the course of our work we have had in view to study to what extent the 20 microscopical soil fungi and 22 Actinomyces strains included in the experiment are able to decompose the humus preparation extracted chemically from the soil. Furthermore we have examined to what extent glucose and cellulose added to the fluid medium as a complementary carbon source and NH_4NO_3 used as complementary nitrogen source can promote, either separately or together, the discolourization of the fluid medium of humus content by examined microorganisms. The overwhelming majority of the microscopical fungi and Actinomyces included in the experiment has been isolated from the chernozem soil with lime mycelia of the Nagyhörcsög Experiment Station of the Research Institute of Soil Science and Agricultural Chemistry of H. A. S. From the same soil was extracted also the humus substance added to the culture medium. The most important chemical data of the examined soil was published in another paper.

For the experiment, Na-humate was utilized which was extracted from the aforesaid soil with the method of TYURIN (1951). The method is based on the following procedure: the $CaCO_3$ is removed from the soil with hydrochlorid acid treatment and subsequently with repeated washing in water, the humus acids are dissolved with NaOH of 0.1 *N* concentration and when the substrate containing the humate is freed completely from mineral colloids with repeated filtering the humate is precipitated with hydrochloric acid, then it is filtered and the dark coloured precipitation is washed through many times with distilled water. The humus colloids thus cleaned are dried under infrared lamp.

The experiment was conducted with the above-mentioned 20 microscopical fungi and 22 Actinomyces strains in three repetitions in the following six treatments: I. Humus as only carbon and nitrogen source. II. Humus + glucose. III. Humus + cellulose. IV. Humus + + NH_4NO_3. V. Humus + glucose + NH_4NO_3. VI. Humus + cellulose + NH_4NO_3.

Of the Na-humate extracted from the soil according to the method described, 0.2 g were weighed and added to 500 ml 0.02 *N* NaOH solution and after complete dissolution the dark coloured solution was sterilized by the cold process, that is by filtration through the Seitz EK filter. This kind of sterilization was chosen because in the case of autoclave sterilization—the high temperature may have cause changes in the chemical bonds of the humic acid molecule hereby also influencing mineralization. As a culture medium a nutrient solution of mineral composition was used, prepared in the following way: 0.1 per cent $MgSO_4$ and KCl were dissolved in distilled water. To the solution in the case of treatments II and V glucose and in treatments IV, V and VI ammonium nitrate were added, the former in 1 per cent, the latter in 0.02 per cent concentration. In the treatments with cellulose (III and VI) the cellulose was measured in straightly into the culture flasks. For this purpose 100 ml Erlenmeyer flasks were used in which 25 ml of the solution, prepared according to the corresponding treatments, was weighed in and subsequently sterilized under 0.5 at. pressure for 40 minutes. Concurrently a Sorensen phosphate buffer of pH 7 reaction was prepared and sterilized separately. Under sterile conditions 20 ml *M*/15 phosphate buffer was then weighed in into 100 ml Erlenmeyer flasks containing the 25 ml fluid medium. This served partly the stabilization of the reaction of the cultural medium and at the same time provided for the phosphorus requirement of the microorganisms to be inoculated. Then 5 ml Na-humate solution was added into each flask and it stained the whole fluid medium dark red. Hereby the fluid medium in every Erlenmeyer flask was completed to 50 ml each containing equally 0.01 per cent Na-humate or — according to the treatments employed — 0.5 per cent glucose or cellulose and 0.1 per cent NH_4NO_3.

The culture medium thus prepared was inoculated with the spore suspension of the one week old culture of the microscopical soil fungi and Actinomyces included in the experiment and the level of the culture medium in the flasks was marked because the water evaporating in the course of incubation had to be supplemented. Incubation lasted in a 28°C thermostat for 6 months. In the last months of the culture period we did not supplement the evaported water any more in order to be able to carry back — in the course of evaluation — the humates dissolving from the mycelia into the fluid medium.

When the incubation period was finished the fluid medium — which had had a loss of about 15—20 ml owing to the last months' evaporation — was filtered and poured into a volumetric flask of 50 ml. Both literary data (AMBRÓŽ 1956, MISHUSTIN—NIKITIN 1961) and our own observations indicate that some fungus strains adsorbe the humate compounds on the lower part of their mycelium membrane while others store them in the interior of the hyphae. According to our assumption this adsorption is due to the fact that the mycelia acidify the fluid medium in their immediate vicinity and this results in the precipitation of the humus colloids being there in solution so that the colour of the culture medium lights up to various degrees. To eliminate the experimental source of error thus arising, the mycelium membrane was ground, in the presence of quartz sand, in a Petri-dish, the humates were elutriated from it with a weak base and, after filtering the filtrate was poured into the volumetric flask containing the fluid medium filtrate, then it was completed to 50 ml with distilled water.

The intensity of humus mineralization was concluded from the intensity of discolouration which was determined photometrically; the obtained values were related to the data of a standard diagram plotted with the utilization of humus quantities already known and thus the amount of the decomposed humus was expressed in mg.

To eliminate the disturbing effect of the pigment substances produced by the fungi we incubated the strains also on a culture medium containing no humus. It has been established that the pigment substances synthesized by us do not exercise a considerable disturbing effect, since we have not, from either of the strains, obtained measurable values.

Parallel with the determination of the intensity of humus decomposition we have also demonstrated the amount of the complementary carbon source that remained in the culture medium. The non-utilized glucose was determined with Bertand's method, while the cellulose determination was carried out gravimetrically. The results of the experiment are presented in Tables 1 and 2.

Results

From the data of the examinations it can be concluded that there are essential differences as regards the humus-decomposing activity of the microscopical fungi and Actinomyces included in the experiment. Microscopical fungi are able to decompose the Na-humate chemically extracted from the soil only if the fluid medium — in addition to humus — also contains a more easily assailable source of energy. In the case of the experimental variant where Na-humate exclusively constitutes only carbon source, no examined microscopical fungus is able to grow. Neither could be growth observed in the treatment where ammonium nitrate was supplied as complementary nitrogen source. On the other hand, the majority of the studied Actinomyces are able to attack Na-humate without a complementary carbon and nitrogen source and a few strains, such as S_9, 1_{59}, 2_{30} and 2_{51}, can minaralize a considerable amount of Na-humate even under such conditions. The complementary nitrogen source does not increase the mineralization of humus in Actinomyces either, as the obtained decomposition values do not considerably differ from the data of treatments containing Na-humate only.

It also appears from the data that, as a result of the introduction of complementary carbon sources into the fluid medium, a substantial part of the

Table 1

Mineralization of humus by Actinomyces

Denomination of the strains examined *Streptomyces*	Treatments									
	1	2	3		4		5		6	
	Complementary carbon and nitrogen source									
	Control	NH_4NO_3	Glucose		Glucose + NH_4NO_3		Cellulose		Cellulose + NH_4NO_3	
	Amount of Na-humate and complementary carbon source utilized mg/50 ml nutrient solution									
	Na-humate	Na-humate	Na-humate	glucose	Na-humate	glucose	Na-humate	cellulose	Na-humate	cellulose
Str. flavovirens (S_{2a})	—	—	0.15	5.3	3.67	250	0.68	22.5	0.50	129.9
Str. flavovirens (S_9)	0.25	—	0.42	20.5	1.35	250	0.75	17.9	0.90	116.4
Str. flavovirens (S_{24})	—	—	0.95	26.5	3.10	250	1.77	30.2	1.67	148.4
Str. venezuelae (S_{29})	—	—	0.35	21.9	3.50	250	1.92	22.5	3.35	115.9
Str. phaeochromogenes (M_1)	0.35	0.05	0.10	19.0	3.50	250	1.77	13.2	2.55	114.5
Str. roseolus (M_6)	0.30	0.07	0.15	18.3	1.95	250	2.02	26.9	1.65	133.5
Str. oidiosporus (M_{20})	—	0.72	0.55	—	2.77	250	0.60	19.5	1.20	107.6
Str. antibioticus (M_{60})	0.37	—	0.42	19.2	3.07	250	1.07	20.5	3.35	135.2
Str. levoris (T_2)	—	0.05	0.50	32.8	0.70	250	0.60	8.1	1.65	10.3
Str. sp. (S_{16})	0.72	0.25	0.80	78.7	2.62	250	1.40	27.6	1.90	122.6
S *Albosporeus* (1—9)	0.15	—	0.55	106.0	0.85	250	1.07	13.5	2.05	62.9
Albus sterilis (1—20)	0.05	0.40	0.60	14.0	2.85	250	0.20	0.7	1.00	7.1
e *Albus* (1—40)	0.25	0.05	1.27	15.7	0.50	250	0.90	7.6	0.97	4.8
Collinus (1—51)	—	0.32	0.60	38.7	2.22	250	1.07	24.5	0.77	164.2
r *Chartreusis* (1—56)	—	—	0.70	13.7	4.25	250	1.25	12.5	2.05	53.8
Chartreusis (1—59)	0.70	0.32	0.35	33.3	3.00	350	1.15	8.5	2.07	44.2
i *Albus sterilis* (2—30)	0.60	0.87	0.60	108.2	1.35	250	1.90	12.9	2.25	102.2
Chartreusis (2—40)	—	1.00	1.27	73.7	3.50	250	3.32	19.1	3.25	106.7
Chartreusis (2—51)	0.87	—	1.05	71.7	3.10	250	1.55	38.4	1.77	105.0
e *Venezuelae* (4—15)	0.15	—	0.60	28.0	1.07	250	1.10	28.4	2.07	97.5
Chartreusis (4—36)	—	0.30	0.60	17.0	3.77	250	1.10	5.2	2.27	48.1
s *Violaceurectus* (4—39)	0.35	0.10	0.45	75.0	2.02	250	1.15	26.4	1.50	70.4

Original amounts: humus 5 mg/50 ml cultural medium
glucose 250 mg/50 ml cultural medium
cellulose 250 mg/50 ml cultural medium

Table 2

Mineralization of humus by microscopical fungi

Denomination of the examined fungus strains	Treatments									
	1	2	3		4		5		6	
	Complementary carbon and nitrogen source									
	Control	NH_4NO_3	Glucose		Glucose + NH_4NO_3		Cellulose		Cellulose + NH_4NO_3	
	Amount of Na-humate and complementary carbon source utilized mg/50 ml nutrient solution									
	Na-humate	Na-humate	Na-humate	glucose	Na-humate	glucose	Na-humate	cellulose	Na-humate	cellulose
Aspergillus candidus (L—1)	—	—	—	18.2	2.82	250	—	40.9	1.15	88.6
Penicillium piscarium (L—2)	—	—	1.20	19.5	2.90	250	1.75	60.0	3.30	250
Penicillium nalgiovensis (Ksz—11)	—	—	1.30	128.7	3.57	250	—	171.0	2.62	250
Penicillium sp. *P. funiculosum* series (511)	—	—	—	—	1.30	250	1.00	105.3	—	250
Penicillium pallidum	—	—	1.85	139.2	1.60	250	2.15	70.1	2.60	250
Penicillium verruculosum (1—5)	—	—	—	—	—	250	3.00	209.1	—	109
Penicillium sp. *P. purpurogenum* series (Ksz—14)	—	—	1.47	150.0	—	250	2.77	136.2	—	250
Penicillium sp. (L—8)	—	—	1.52	147.0	—	250	1.80	151.7	—	250
Fusarium avenaceum (L—6) var. *herbarum*	—	—	—	104.0	—	250	1.02	40.3	—	250
Fusarium aquaedectuum var. *dimerum* (tn—22)	—	—	1.45	115.4	4.00	250	1.80	32.6	—	250
Hormodendrum sp. (L—11)	—	—	1.50	130.5	4.50	250	1.20	41.8	2.42	250
Fusarium sp. (602)	—	—	1.50	139.6	—	250	1.60	43.7	—	250
Fusarium solani var. *argillaceum* (L—12)	—	—	—	140.0	3.30	250	1.80	29.4	3.72	250
Fusarium nivale (L—4)	—	—	1.62	135.5	—	250	1.10	31.2	—	250
Veticillium candellabrum (L—13)	—	—	1.35	135.7	1.25	250	3.12	60.2	2.07	250
Nigrospora sp.	—	—	1.50	72.5	3.85	250	2.65	31.3	—	250
Sterile mycelium (L—9)	—	—	1.55	140.0	—	250	1.37	57.1	—	250
	—	—	0.85	—	1.55	250	2.55	31.7	—	250
	—	—	4.05	—	4.20	250	2.40	14.1	3.52	119.8

Original amounts: humus 5 mg/50 ml cultural medium
glucose 250 mg/50 ml cultural medium
cellulose 250 mg/50 ml cultural medium

examined fungi are able to attack and decompose Na-humate. When of the carbon sources cellulose was added to the culture medium, 80 per cent of the fungi included in the experiment decomposed the humate while only 65 per cent exhibited the same effect when glucose was applied. Both on the application of glucose and cellulose as complementing carbon sources Actinomyces were able to decompose Na-humate completely, but the humus decomposing activity of the various species or strains, respectively, differs substantially from each other.

In microscopical fungi the complementary nitrogen source has no considerable role in the decomposition of Na-humates when it is given together with glucose or cellulose, because it does not substantially influence the intensity of discolouration. As it appears from the data of diagram 1 in such cases less fungi discolour the nutrient solution than in the variant which contains only a complementary carbon source. The position is different with Actinomyces because in their case the combined dosage of the complementary carbon and nitrogen sources considerably increases the amount of the decomposed Na-humate in the majority of cases.

The above examinations corroborate the literary data according to which a certain connection can be demonstrated between the mineralization of the organic matters of the soil that are being more and less easily decomposed. From the experimental data it appears that in the case of fungi only in those treatments could humus decomposition be observed where a complementary carbon source was present while the complementary carbon nitrogen source did not elicit such effect. On this basis we assume that the fungi examined by us can utilize the humus in the first place as a nitrogen source, that is, they decompose its nitrogen containing component while as carbon source the organic matters more readily available in nature can serve. Since various plant residues that may be taken up as complementary carbon source get into the soil in great amounts, we assume that the microbiological transformation of these not only increases the amount of the humus substances in the soil but it may promote the mineralization of the already humified organic matters as well.

In conformity with literary data the Actinomyces have proved to be active humus decomposers even without complementary source of energy and are presumably deeply involved in the decomposition of humus substances.

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CONTRIBUTION TO THE AUTECOLOGY OF ACHILLEA FRAGRANTISSIMA (FORSK.) SCH. BIP.

WITH REFERENCE TO ITS OIL CONTENT

By

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The environmental conditions including climatic ones and soils supporting *A. fragrantissima* in three different localities in the arid Egyptian deserts have been examined and analysed. Wadi Rishrash is the most favourable habitat for *A. fragrantissima* as indicated by its dominance and high content of volatile oil in that locality. The effect of rainfall and depth of seed bed on germination have been studied. And the reproductive capacity, range of osmotic pressure of plant sap, size and weight of seed, etc., have also been recorded.

Introduction

Achillea fragrantissima (Forsk.) Sch. Bip. is a perennial under-shrub with delightful fragrance growing in the inner dry desert. It has small, yellow, corymbose heads, leaves small, sessile, oblong-linear to ovate, serrate. In winter the shoots dry up, and in late spring new buds emerge. Flowering and fruiting take place in summer. It is known under the vernacular names, Be'eithraan and Qaysoom. It is recorded in four phytogeographical regions of Egypt (TÄCKHOLM 1956).

A series of papers have been published on the phytochemistry of *A. fragrantissima* collected from Wadi Hof (SHALABY *et al.* 1964, 1965). The present paper is a further contribution to the ecology of the same species.

Material and Method

The object of the present study is to investigate the effect of microhabitat factors and soil characters under which *A. fragrantissima* can live and consequently, the effect of such factors on the volatile oil content of this economically desirable desert plant. For this purpose, soil samples and plant materials have been collected from three representative localities in the Eastern desert, namely, Wadi Hof near Helwan, about 35 kilometers South of Cairo; Wadi Rishrash near El-Saf, about 75 kilometers South of Cairo; and Wadi Aber near Suez, about 150 kilometers East of Cairo.

In the present study, the authors attempt to carry out some investigations on the problems of germination and the distribution of the species under study in different plant communities.

Many authors have contributed to our knowledge on the plant communities and soil of Wadi Hof (e.g. STOCKER 1926—1927, MONTASIR 1938, KASSAS—IMAM 1954).

Results

Environmental factors. The species shows a good growth in the inner desert where the annual mean temperature varies from 20.8 to 22.4° C in the localities under investigation, and the maximum temperature varies from 45.0 to 47.5° C in summer and the minimum is 1.3° C in winter. The atmospheric relative humidity is relatively low, varying from 20 to 65 per cent. The wind velocity ranges between 13.1 and 20.2 km/h. Evaporation is high, its mean monthly rate fluctuates between 5.1 and 16.5 mm/day. According to the Climatological Normals of Egypt (1950), the annual mean value of rainfall varies from 27 to 31 mm in the different localities and is quite sporadic.

In addition to the climatic conditions, soil factors play a prominent role in the constitution and distribution of Achillea in different communities.

Analysis of the soil supporting *A. fragrantissima* shows that it is usually of shallow coarse sand (Table 1) which may be derived from sandstone, limestone, or crystalline rock.

In all cases, the total soluble salts is low, not exceeding 0.195 per cent. The soluble salts are mostly sulphates and chlorides. The organic matter of soil under *Achillea fragrantissima* is rather low (less than 0.350 per cent). The soil reaction is alkaline. The carbonate content in these soils ranges between 44.25

Table 1

Analysis of soils under A. fragrantissima

Locality	Sample No.	Depth	Soil colour and texture	Granulometric analysis			
				> 2.0 %	2.0 0.21 %	0.21 0.125 %	<0.152 %
Wadi Hof	1	Surface	Yellowish light brown sandy-loam	3.0	57.0	7.0	33.5
Wadi Hof	2	0—25 cm	Yellowish light-brown sand	7.0	27.0	6.5	59.5
Wadi Hof	3	0—25 cm	Yellowish light-brown sand	42.0	38.0	3.5	16.5
Wadi Hof	4	25—50 cm	Yellowish light-brown sand	27.5	32.5	8.0	32.0
Wadi Rishrash	5	0—25 cm	Yellowish light-brown sand	51.0	29.5	4.5	15.0
Wadi Aber	6	0—25 cm	Yellowish light-brown sand	52.0	29.1	2.4	16.5
Wadi Aber	7	0—25 cm	Yellowish light-brown sand	54.5	8.3	3.0	34.0

and 55.5 per cent. Soils contain soluble phosphates. Analysis of HCl extract shows that all soils contain Ca, but are free from Al and Fe.

Associate plants. In studying the plant communities in the three different localities (Table 2), the constituent species were listed and every species was assigned two figures, the first representing a combined scale of abundance — dominance and the second representing the sociability. Each of these characters was studied according to a six-degree scale as follows.

Degree of abundance—dominance; 5 = very abundant with coverage from 75 per cent — 100 per cent, 4 = abundant with 50 per cent — 75 per cent, 3 = fairly abundant with 25 per cent — 50 per cent, 2 = rare with 5 per cent — 25 per cent, 1 = very rare with 1 per cent — 5 per cent, and + = just present with 1 per cent.

Sociability index; 5 = in great crown or forming pure populations, 4 = in small colonies, 3 = in troops, small patches or cushions, 2 = grouped or tufted, 1 = grouped in a place singly, + = rare or very rare individuals, growing singly.

Performance of the plant in various localities. A. fragrantissima reaches a mean height of 22.5 ± 2.3 cm in Wadi Rishrash, 53 ± 4.5 cm in Wadi Hof, and 45.6 ± 11.9 cm in Wadi Aber.

in different localities studied

CO_3 %	Cl %	SO_4 %	NO_3 %	T. D. S. %	Organic matter %	PH	Soluble PO_4	HCl extract		
								Al	Fe	Ca
54.2	0.014	0.04	0.0001	0.110	0.196	7.5	++	—	—	+++
44.25	0.015	0.082	0.00001	0.170	0.360	7.9	++	—	—	+++
55.0	0.016	0.04	0.00002	0.150	0.300	8.0	++	—	—	+++
48.0	0.05	0.12	0.00004	0.195	0.246	7.8	+++	—	—	+++
54.0	0.002	0.033	0.00002	0.095	0.276	7.9	++	—	—	+++
55.5	0.024	0.04	0.00002	0.125	0.288	7.8	+	—	—	+++
53.2	0.026	0.037	0.00002	0.110	0.282	7.8	+	—	—	+++

Amounts of the substances: +, small; ++, moderate; +++, large.

Table 2

Phytosociological studies of three stands

Species	stand*		
	1	2	3
Achillea fragrantissima (Forsk.) Sch. Bip.	2.1	1.1	1.1
Pulicaria cripsa (Forsk.) Benth & Hook. f.	2.1	—	—
Iphiona mucronata (Forsk.) Asch. et Schweinf.	1.1	+.+	—
Zilla spinosa (Turra) Pranth.	1.1	3.2	1.+
Zygophyllum coccineum L.	1.1	1.1	2.2
Fagonia mollis Del.	+.+	1.1	+.+
Pithyranthus tortuosus (Desf.) Benth. & Hook. f.	+.+	1.+	+.+
Reaumuria hirtella Joub. & Sp.	+.+	1.+	—
Gymnocarpus decandrum (Forsk.)	1.1	+.+	—
Ochradenus baccatus Del.	1.1	—	—
Farsetia aegyptiaca Turra	+.1	—	—
Pulicaria undulata (L.) Kostel.	+.+	—	1.1
Artemisia judiaca L.	+.+	—	+.+
Asteriscus graveolens Less.	+.+	1.+	—
Haloxylon salicornicum (Moq.—Tand.) Boiss.	+.+	—	+.+
Anabasis articulata (Forsk.) Moq.—Tand. in DC.	+.+	—	—
Cucumis prophetarum L.	+.+	—	—
Launaea spinosa (Forsk.) Sch. Bip.	+.+	—	1.+
Stachys aegyptiaca Pers.	+.+	1.+	—
Retama raetam (Forsk.) Webb & Berth.	+.+	—	+.+
Linaria aegyptiaca (L.) Dum. Cours.	+.+	—	—
Panicum turgidum (Forsk.)	+.+	—	—
Capparis spinosa L.	+.+	+.+	+.+
Asphodelus fistulosus L. v. *tenuifolius* Cav.	—	—	+.+
Crotalaria aegyptiaca Benth.	—	—	+.+
Aristida scoparia Trin. & Rupr.	—	—	+.+
Halogeton alopecuroides (Del.) Moq.—Tand.	—	—	+.+
Colocynthis vulgaris Schrad.	—	—	+.+
Forskohlea tenacissima L.	—	—	+.+
Zygophyllum decumbens Del.	—	—	2.2
Lavandula stricta Del.	—	—	1.+
Lycium arabicum Schweinf.	—	—	+.+
Cleome droserifolia (Forsk.) Del.	—	—	1.1
Pennisetum dichotomum (Forsk.) Del.	—	1.+	—
Anabasis setifera Moq.—Tand.	—	+.+	—
Gyusophila capillaris (Forsk.) C. Chr.	—	1.+	—

* 1 = Wadi Rishrash, 2 = Wadi Hof, 3 = Wadi Aber.

The average seed output is shown in Table 3, together with germination and the reproductive capacity of Achillea at different localities.

Size and weight of seeds. The seed has an average weight of 0.19 mg. The length of the seed varies from 1.5 to 2.5 mm and the breadth from 0.8 to 1.0 mm. The shape index, expressed as length/breadth ratio varies from 1.9 to 2.0.

Germination. WENT (1953) has emphasized the fact that temperature and rainfall play an important role in the germination of seeds under desert conditions. In the present work some experiments have been carried out to study the effect of artificial rain and depth of seed bed on the germination of *Achillea fragrantissima* seeds.

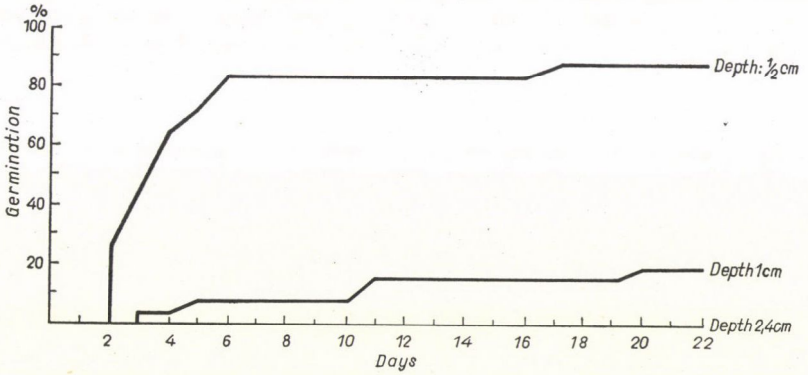

Fig. 1. Effect of rainfall on germination of seeds of *Achillea fragrantissima*

a) *Effect of rainfall.* Amounts of water equivalent to 5, 10, 20, and 30 mm rain were added as spray simulating rain. A number of glass jars, filled with sandy soil, each containing 25 seeds was placed about one-half cm below the soil surface. This was done at room temperature which fluctuated between 21 and 26°C.

An addition of 10 mm permitted germination of only 30 per cent of the seeds by the 3rd day (Fig. 1). On the 10th day seedlings started to wilt as the

Table 3

Seed output, germination and reproductive capacity of A. fragrantissima at three different localities

Locality	Average number of fruits per plant	Average number of seeds per fruit	Seed output per plant	Germination %	Reproductive capacity
Wadi Rishrash	546	9	4914	100	4914
Wadi Hof	1092	8	8736	80	6988
Wadi Aber	4200	6	25200	30	7560

superficial soil dried out. But the addition of 10 mm, 20 mm, and 30 mm permitted germination of 50, 60, and 80 per cent of seeds respectively. Wilting started on the 10th day in the case of 10 mm, and on the 12th day in the case of 20 and 50 mm. The results as shown in Fig. 1 indicate that high germination has occurred under 20 and 30 mm rain.

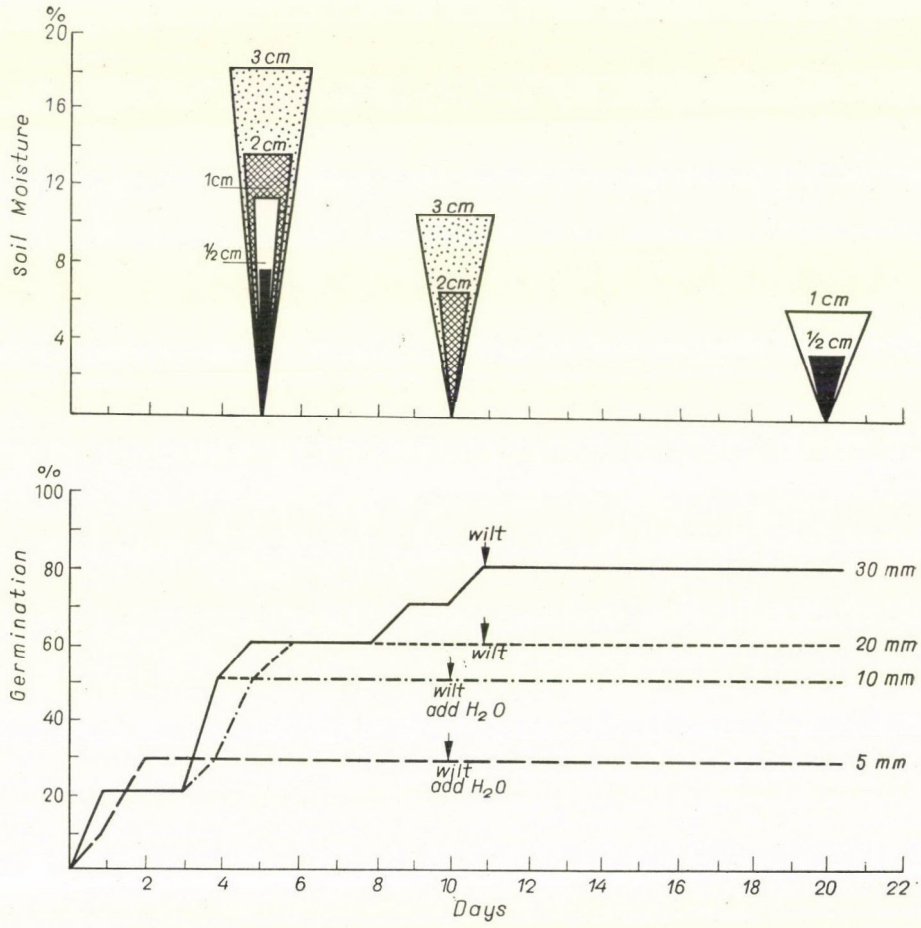

Fig. 2. Effect of depth of seed bed on germination of *Achillea fragrantissima*

b) *Depth of sowing.* In this experiment seeds were sown in small pots one-half cm below the surface as well as at depths of one cm, two cm, and four cm. Soil moisture content was maintained at the field capacity throughout the experiment. Results are shown in Fig. 2.

Those seeds sown just below the surface with one-half cm showed a higher percentage of germination and the percentage of emerged seedlings was greatly diminished with depth.

Table 4

Oil content, moisture content and osmotic pressure of the cell sap of Achillea fragrantissima collected from different localities on Sept. 1966

Locality	Oil %(v/w) calculated on fresh weight bases	Osmotic pressure (atm.)	Moisture content (% dry weight)
Wadi Rishrash	1.18 ± 0.02	26.4 ± 0.30	42.5 ± 1.4
Wadi Hof	0.26 ± 0.05	33.1 ± 0.05	44.5 ± 1.4
Wadi Aber	0.34 ± 0.005	29.1 ± 0.10	42.5 ± 1.4

Oil content. The effect of the environmental conditions on the volatile oil content of the plant has been investigated. Four samples of each plant collection were assayed according to the B. P. method (1948) for the volatile oil content, and the average values are represented in Table 4. In every determination the assay was carried out 2 hours after the collection of the sample from its natural habitat. The oil content of the material collected from Wadi Rishrash was higher than that in the other two localities as shown in Table 4.

Osmotic pressure of the plant sap. In Table 4 is given the osmotic pressure obtained for Achillea in the different localities. The osmotic pressure of the plant sap ranges from 26.4 to 33.1 atm.

Such difference in osmotic pressure may be the result of an accumulation of salts rather than of moisture deficiency.

Discussion

The best conditions under which *Achillea fragrantissima* can thrive, and produce the highest amount of volatile oil content, can be determined through ecological studies including the range of natural habitats in which this species lives, and the effect of habitat factors on growth, establishment and distribution of the plant in different regions.

A. fragrantissima which is a desert perennial with delightful fragrance, has been found only within the arid desert, namely, Wadi Hof, Wadi Rishrash, and Wadi Aber.

Such desert is generally characterised by low rainfall, high evaporation, and low wind velocity.

Under such climatic conditions Achillea species become dry in winter, and they reach their peak of growth in August—September.

As the soil factors play a prominent role in the constitution and distribution of Achillea communities, accordingly the physical and chemical properties of the soils supporting *Achillea fragrantissima* were studied.

From the vegetation analysis, it seems that Wadi Rishrash is more favourable for the growth of *A. fragrantissima* as indicated by its dominance in that

habitat than in other localities. WEAVER—CLEMENTS (1938) stated that every plant was a product of the conditions under which it had grown and was therefore a measure of environment.

The germination experiments reveal that the upper few millimeters of the soil is more favourable for germination. If seeds are buried to few centimeters, their chance for germination will be diminished.

A rainfall of 5 mm suffices for the germination of Achillea seeds but additional showers are needed for seedling survival.

In spite of the very high reproductive capacity of this plant and the tremendous number of seeds produced by a single plant which seeds are estimated to be as much as 25,000, the yearly addition of new plants in a stand to those already existing is very limited due to improper conditions naturally occurring in the desert.

The highest reproductive capacity of *A. fragrantissima* works out to 7560.

The big difference in the amount of volatile oil content between plants growing in Wadi Rishrash, and in the other two localities may be due to the difference in the degree of expression of the characters under different environmental conditions including climatic and edaphic factors, together with topography. Accordingly, the most favourable locality for oil production from Achillea plant is Wadi Rishrash, provided there are no inherent genetic differences in oil production by the plants growing at these different localities.

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FACTORS INFLUENCING THE QUANTITATIVE ANATOMICAL CHARACTERS OF THE VINECANE

I. EFFECT OF THE SHOOT MORPHOLOGY AND OF THE LOADING OF PLANT

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Quantitative anatomical measurements and counts have been carried out on the cross section of the shoots of *Berlandieri* × *riparia T. 5 C* vine stock variety. On the cross sections taken from the same level of all canes of 12 plants there has been examined the influence of the shoot number, height and thickness of the shoot and the length of internode on the inner structure of the plant. It has been established that several of the quantitative anatomical indices significantly differ from each other according to the groupings examined. Thus if the intention is to examine ecological or varietal differences it is suitable for the purpose in view to take — at sampling — into consideration the shoot morphology and the loading of the plant.

Introduction

Comparative histological examination of the one year old (mature) canes is important both from the theoretical and practical viewpoints; still in this field prior to the author's investigations no serious attempts had been made. In our earlier examinations (HEGEDÜS 1960, 1963, 1964) we demonstrated that there were quantitative anatomical differences in the shoots of various stock varieties, but these features might change upon the action of environmental conditions and also the various shoot levels might differ from each other up to a certain degree. In the course of our new investigations we have searched for an answer to the question whether the canes of the same variety and produced under identical ecological conditions differ from each other according to number and length of the shoots and to the thickness and length of the internode.

Material and Method

In conformity with our objective we examined at the station of the Research Institute of Viticulture in Eger all canes obtained in 1962 of 12 *Berlandieri* × *riparia T. 5 C* stock plants. The plants were selected to include 2 each with 8, 7, 6, 4, 3 and 2 canes. Thus a total of 60 canes were examined.

After picking, the full length of the canes was measured and from every cane one of the 9—11th internodes falling between two tendrils was cut out. Of this internode the length was measured as well as the smallest and greatest thickness in the middle where a cross section was then produced. With measurement and count and by comparing the individual values 20 quantitative anatomical indices were established. On the cross sections produced in surveying the indices the following proceeding was carried out. The sections were placed in a photographical enlarger and photoprints of tenfold magnification prepared. On these photoprints the least (b) and greatest (B) diameter of the pith as well as the least (f) and greatest (F) thickness of the xylem were measured. These dimensions had to be taken from photoprints because in the

microscope available only a small part of the section was visible at a time even at the lowest magnification so that it was rather difficult to find and to measure the proper sites. These photoprints were used also in further measurements for orientation. The other measurements were performed in the microscope with 100—200 × magnification. We measured lowest (h) and greatest (H) thickness of the phloem extending from cambium to phellogen. At the broadest site of the phloem we also measured the part of full thickness constituted by the combined thickness of the hard phloem layers. Subsequently in the phloem per sectors between the rays we counted the hard phloem layers and calculated their average number (kh). When establishing the sectors all primary and secondary rays were taken into consideration and so the number of sectors fixed at the same time the total number of rays (bs). At the border of xylem and pith (medullary sheath) we established the number of the primary rays (practically the primary xylem bundles were counted: bs_1). The difference between the number of total and primary rays gave the number of the secondary rays (bs_2). The diameter of the greatest trachea was measured at 4 places in each section. At the broad sides or the shoot we selected the 3 adjacent vascular bundles in which the tracheae were the smallest and in these we measured the diameter of the largest trachea (t). Scrutinizing the ventral and dorsal sectors in a greater width we selected and measured the trachea of the greatest diameter (T_1 or T_2 respectively). After finishing the measurements several relative numbers were calculated. So to express the flattening of the pith the proportion between great and small diameter (B/b) was calculated; to express the unevenness of the thickness of the xylem the proportion between greatest and smallest thickness (F/f), to express the xylem to pith ratio the double sum of the smallest and greatest thickness of the xylem divided by the sum of the small and great diameter of the pith (fb) were obtained, for the unevenness of the phloem the H/h ratio, for the relative thickness of the hard phloem layers the total thickness of the phloem divided by the thickness of the hard phloem layers (H/kh) were obtained; further the T/t and T_1/T_2 ratio illustrating the uneven distribution of the size of the tracheae was also counted up. The t and T values were obtained from the arithmetical mean of the two data. When calculating fb we took the double of the sum of the two wood thicknesses in order that the data might better correspond to the xylem to pith ratio taken into consideration in the qualification of the cane maturation. After having determined the 20 quantitative-anatomical scores for all shoots we conducted analysis of variance with them in five different groupings to find out whether there was a significant difference among the groups and what it did amount to. To the first question the answer was supplied by the F-test while the second — provided that the first was favourable — was answered by the calculation of the lsd value. The sign for the F-value (which is the initial of Fisher's name who introduced the test) unfortunately coincides with the sign of the value F introduced by us for marking the greatest thickness of the wood (previously, instead of carrying out an analysis of variance we had controlled with the t-test the validity of the difference of data and thus this problem did not arise at all). We have not considered it advisable to change the system of marking introduced and therefore, to distinguish the two signs we shall always use the F-value for Fisher in italics (*F*). In the first grouping shoots belonging together in each plant were considered as a group, so we had 12 groups with 2—8 members. In the further four cases three groups were formed on the basis of number of canes, cane length, internode length and internode thickness: the group of the small (A), medium (B) and large (C) values. Limits of grouping and number of individuals belonging to them are presented in Table 1.

For the number of shoots the limits of grouping were given, while in the others we tried to establish them so, that each of the three groups should include the same number of individuals. Internode thickness signifies average of the largest and smallest diameter.

Table 1

Limits of grouping and number of individuals

Viewpoint of grouping	Limits of grouping			Number of individuals		
	A	B	C	A	B	C
Number of canes	2—3	4—6	7—8	10	20	30
Cane length, cm	211—400	401—460	461—600	20	18	22
Length of internode, mm	98—197	198—219	220—260	20	19	21
Thickness of internode, mm	5.7—7.3	7.4—7.9	8.0—9.5	19	21	20

Results and Discussion

Table 2, 3 show the mean of all data ($\bar{x}$) and their standard deviation (s), the plant averages and the F and lsd values belonging to them as well as the means, F and lsd values in the further four groupings. Being given the fact that the number of the members in the groups is very different, in the grouping by plants and number of shoots, two limiting values have been given for the lsd the lower of which is valid for the comparison of the two groups with greatest number of members while the higher for that of the two groups with the smallest number of members. Where, according to the F value, there is no significant difference, the lsd value had not been calculated. In the grouping as per plants, they are arranged from 1 to 12 according to the diminishing number of canes.

The smallest and largest diameter of the pith exhibit significant differences in every grouping except for that according to the cane length. Differences are greatest in the grouping for the thickness of internode. In the thin shoot the pith is significantly less than in the thick one. The difference according to the length of internodes is lower but still very important. Only the short internodes differ significantly, distinguishing themselves by smaller pith diameter. From the point of view of number of canes the plants with few canes excel with smaller diameter of the pith. As to the flattening of the pith (B/b) there is no significant difference according to any of the groupings. For the least thickness of the xylem (f) there is a difference only in the grouping according to the thickness of the internode, namely with the increase of thickness f is increasing too. Similar is the situation in case of the greatest xylem thickness (F) but here significant difference occurs also among the plants. As to unevenness of the xylem (F/f) a significant difference arises only among the plants owing to the fact that in the canes of two plants (2 and 12) the xylem is more tapering than in the others. From the point of view of xylem to pith ratio (fb) a significant difference arises according to plants, number of canes and length of internodes. As to the plants only those with two canes (11, 12) differ from the others. Otherwise those with few canes and short internodes are significantly better. From the comparison of the data it appears that the higher xylem to pith ratio is the result of the smaller diameter of the pith. Remarkable is the circumstance that when the internodes of identical morphological position (around node 10, between two tendrils) of different shoots are compared, the shorter internode has a better xylem to pith ratio. With our earlier investigations, on the other hand, we demonstrated (HEGEDÜS 1963) that the fluctuation of the internode length within a shoot did not influence the xylem to pith ratio. As regards the thickness of the phloem (h, H) significant difference is found in the grouping according to thickness: in thin shoots also the phloem layer is thinner. In the case of h rather important differences can be found also among the plants. In

Table

Quantitative-anatomical features mesured on all canes

Basis of comparison		Diameter of pith			
		b	B	B/b	f
Total	$\bar{x}$	3624.58	4369.16	1.21	952.01
	s	466.53	561.61	0.073	179.45
	1	3598.20	4381.15	1.22	972.39
	2	3718.10	4429.11	1.19	827.31
	3	3514.27	4135.35	1.18	990.37
	4	3742.08	4412.32	1.18	919.63
	5	3912.34	4873.93	1.24	923.23
	6	3662.94	4397.93	1.17	937.62
Per plant	7	3722.89	4576.58	1.23	1045.53
	8	3773.25	4642.53	1.23	1069.51
	9	3740.88	4595.77	1.23	1099.48
	10	3141.38	3848.79	1.22	758.97
	11	3105.41	3656.95	1.17	1097.08
	12	2607.82	3345.21	1.30	989.17
	F	2.23*	2.35*	0.93	1.41
	lsd	423.25—846.50	505.98—1007.16	—	—
	A	3207.32	3933.92	1.23	974.79
Number	B	3802.03	4625.74	1.22	980.78
of	C	3644.96	4343.98	1.20	925.63
canes	*F*	6.49**	5.99**	0.93	0.67
	lsd	246.99—330.92	299.75—400.47	—	—
Cane	A	3570.62	4342.78	1.22	962.80
length	B	3585.01	4219.28	1.18	900.45
	C	3704.91	4515.43	1.22	985.58
	F	0.51	1.43	1.92	1.19
	lsd	—	—	—	—
Length	A	3215.72	3903.94	1.22	922.03
of	B	3785.24	4576.58	1.21	941.21
internode	C	3839.20	4592.17	1.19	989.17
	F	16.25***	13.61***	0.62	0.74
	lsd	239.56	297.35	—	—
Thickness	A	3155.77	3824.81	1.22	840.50
of	B	3702.51	4439.90	1.20	924.43
irternode	C	3987.87	4812.79	1.21	1087.49
	F	33.37***	30.83***	0.31	13.79**
	lsd	203.83	249.39	—	94.72

of 12 Berlandieri × riparia T. 5C plants

Thickness of xylem		Xylem to pith ratio	Thickness of phloem		
F	F/f	fb	h	H	H/h
1724.16	1.84	0.68	128.03	520.33	4.25
466.22	0.286	0.161	31.49	67.37	0.950
1737.35	1.81	0.68	120.46	478.70	4.31
1720.57	2.13	0.63	107.85	516.54	4.92
1690.59	1.73	0.70	143.80	520.33	3.66
1567.09	1.72	0.61	121.09	524.11	4.44
1708.57	1.89	0.61	132.45	533.57	4.22
1720.57	1.88	0.65	118.57	492.58	4.19
1954.37	1.92	0.72	131.19	609.89	4.84
1728.96	1.62	0.68	160.20	517.80	3.30
1778.12	1.62	0.69	162.72	561.95	3.48
1334.49	1.78	0.61	87.04	453.47	5.23
2008.32	1.83	0.94	167.77	567.00	3.41
2158.20	2.16	1.13	125.51	544.92	4.34
2.19*	10.39***	6.72***	2.75**	1.73	2.13*
241.00—482.00	0.17—034	0.11—0.22	27.12—54.87	—	0.87—1.73
1767.33	1.82	0.80	133.71	527.27	4.16
1764.93	1.84	0.66	133.71	533.57	4.15
1682.20	1.86	0.66	122.36	508.97	4.35
1.18	0.06	29.69***	0.91	0.85	0.31
—	—	0.07—0.09	—	—	—
1686.99	1.78	0.69	128.66	514.02	4.25
1701.38	1.92	0.67	121.72	512.76	4.36
1775.72	1.84	0.68	133.08	531.68	4.17
0.67	1.19	0.05	1.54	0.50	0.21
—	—	—	—	—	—
1767.33	1.96	0.78	118.57	510.24	4.54
1683.40	1.83	0.63	133.08	517.17	4.06
1724.16	1.76	0.64	131.82	531.68	4.18
0.46	2.58	5.76**	1.33	0.54	1.36
—	—	0.094	—	—	—
1628.24	1.96	0.73	110.37	481.85	4.57
1654.62	1.82	0.64	124.88	526.00	4.42
1888.42	1.76	0.68	148.85	578.98	3.77
6.92**	2.63	1.55	9.84***	6.05***	4.44*
153.47	—	—	17.66	39.73	0.57

Table 3

Quantitative-anatomical features measured on all canes

Basis of comparison		Hard phloem layers		Tracheal diameter	
		number	thickness		
		kh	H/kh	t	T
Total	$\bar{x}$	1.92	4.66	96.50	208.13
	s	0.298	1.20	29.10	22.82
	1	1.78	4.12	99.65	223.90
	2	1.75	4.75	81.99	206.24
	3	2.02	4.95	105.33	199.93
	4	1.87	4.73	97.13	198.04
	5	2.09	5.15	107.22	222.64
	6	1.75	3.87	93.97	204.35
	7	2.04	4.71	101.54	217.59
Per plant	8	2.22	3.91	94.60	204.35
	9	2.21	4.76	104.70	199.30
	10	1.51	5.86	76.31	179.75
	11	2.22	4.81	92.71	233.36
	12	1.99	5.46	93.34	196.78
	F	3.18**	1.09	0.98	4.58**
	lsd	0.25—0.50	—	—	18.92—38.47
Number of canes	A	1.96	5.24	91.45	199.93
	B	2.01	4.43	99.65	212.55
	C	1.85	4.62	95.87	207.50
	F	1.83	1.60	0.40	2.32
	lsd	—	—	—	—
Cane length	A	1.93	4.54	91.45	198.67
	B	1.93	4.66	93.97	206.24
	C	1.91	4.77	102.17	217.59
	F	0.16	0.18	0.90	8.89***
	lsd	—	—	—	12.61—13.24
Length of internode	A	1.86	4.72	90.19	203.08
	B	1.96	4.50	93.97	206.87
	C	1.94	4.76	102.17	213.18
	F	0.64	0.27	1.62	2.15
	lsd	—	—	—	—
Thickness of internode	A	1.78	5.03	88.30	192.36
	B	1.83	4.30	95.24	212.55
	C	2.14	4.70	104.70	217.59
	F	11.72***	1.93	9.40***	17.84***
	lsd	0.16	—	11.98	8.83

of 12 Berlandieri × riparia T. 5C plants

		Number of pith rays			
T/t	T_1/T_2	bs_1	bs_2	bs	1/2
2.34	1.08	48.58	26.00	74.58	2.06
1.21	0.14	3.52	6.71	7.21	0.80
2.34	1.07	48.25	24.37	72.62	2.13
3.56	1.10	51.50	21.75	73.25	2.75
1.88	1.12	47.14	26.14	73.28	2.21
2.05	1.04	48.57	24.57	73.14	2.09
2.09	1.08	48.67	30.50	79.17	1.64
2.21	1.08	45.50	27.50	73.00	1.65
2.20	1.14	51.00	28.25	79.25	1.87
2.18	1.07	49.25	29.25	78.50	1.72
1.91	1.03	53.00	30.33	83.33	1.75
2.39	1.02	47.33	17.00	64.33	2.80
2.52	1.03	44.00	34.00	78.00	1.30
2.11	1.02	46.00	24.00	70.00	1.91
0.98	23.83***	2.78**	1.80	2.02*	1.53
—	0.06—0.13	3.06—6.11	—	6.63—13.3	—
2.22	1.03	48.10	25.80	73.90	2.01
2.17	1.09	48.30	28.90	77.20	1.70
2.49	1.08	48.93	24.13	73.06	2.31
0.48	0.56	0.30	3.26*	2.10	3.73*
—	—	—	3.72—5.00	—	0.44—0.59
2.21	1.07	48.80	25.45	74.25	2.03
2.69	1.09	48.44	24.06	72.50	2.23
2.16	1.07	48.50	28.09	76.59	1.94
1.13	0.07	0.06	1.95	1.66	0.68
—	—	—	—	—	—
2.28	1.06	48.21	28.84	73.05	2.17
2.66	1.08	49.10	27.00	76.10	1.97
2.08	1.09	48.43	26.09	74.52	2.01
1.24	0.18	3.08	0.50	0.87	0.42
—	—	—	—	—	—
2.29	1.07	48.31	21.00	69.31	2.63
2.61	1.07	48.00	27.00	75.00	1.87
2.10	1.09	49.45	29.70	79.15	1.70
0.93	0.07	0.95	12.01***	12.73***	9.46**
—	—		3.62	3.86	0.45

the H/h values expressing unevenness of the thickness of phloem, differences are found according to plants and thickness of canes. In the thick canes the phloem layer is most even. The mean number of the hard phloem layers (kh) differs according to plants and thickness of canes. On the thick shoots the number of the hard phloem layers is greater too. Relative thickness of the hard phloem layers (H/kh) does not show significant differences according to either grouping. The greatest tracheal diameter in the medium sector of the broad sides (t) differs according to thickness of canes: it is significantly greater in the thick canes than in the thin ones. The greatest tracheal diameter exhibits a difference on the narrow sides (T) according to plants, cane length and thickness. It is remarkable that the tracheal diameter is greatest in the longest canes. The quotient of the greatest tracheal diameters of the broad and narrow sides (T/t) does not exhibit according to either grouping significant differences. The quotient of the greatest tracheal diameters of the ventral and dorsal sides (T_1/T_2) significantly differs only between plants. The same statement can be made on the number of the primary pith rays (bs_1). The number of the secondary pith rays differs substantially as to the thickness of canes while to the number of canes in a lesser degree. In thin shoots there are considerably less secondary rays than in the medium or thick ones. As to the number of canes the number of secondary rays is greatest in the shoots of plants with medium number of canes. The total number of rays (bs) differs according to plants and cane thickness. The primary to secondary pith ray ratio (1/2) significantly differs in the grouping concerning cane number per plant and cane thickness.

Conclusions

It follows from what had been exposed that in sampling for comparative anatomical examinations and evaluation of results several viewpoints must be taken into consideration. Significant difference among the plants can be found in the majority of features which means our practice to be right according to which the 10 samples to be examined had been taken from different plants (HEGEDÜS, 1964). From the viewpoint of number of canes there differ the pith diameter, xylem to pith ratio, number of secondary rays and pith ray ratio. It is interesting to note that mostly the plants with a medium number of shoots exhibit extreme values. Regarding cane length there is a difference only in the tracheal diameter (T). It is probable that in the longer shoots wider tracheae develop on account of the increased transport requirement. Considering the internode length there is a significant difference between pith diameter and xylem to pith ratio. This fact corroborates the earlier practical statement (BERNÁTSKY 1908) that shoots with longer internodes exhibit a worse xylem to pith ratio. This does not apply to the periodical alternation of shorter and

longer internodes within the shoot. It is a well known fact that the internodes between two tendrils are the longest and those following immediately upwards the shortest. This difference does not cause a change, however, in the xylem to pith ratio. In the grouping for internodium thickness significant differences are found in the majority of features. In the thicker cane the thickness of pith, xylem and phloem is greater, besides, the phloem is more even and the number of hard phloem layers is higher. The tracheal diameter and the number of secondary and total rays are also greater while the pith ray quotient is smaller. Thus it is evident that if we want to diminish spreading of data we must pay more attention to the evenness of cane thickness. There is no difference between the quotients B/b, H/h and T/t according to any of the groupings and only a difference by plants between the F/f, T_1/T_2 and bs_1 values. Consequently sampling errors must be reckoned with the least in these characters. Most errors can be reckoned with in the pith diameter (b, B) which, except for the cane length, exhibits significant differences in any other grouping.

As a final result of the examinations it may be established that when studying the variability caused by varietal and ecological factors of the quantitative-anatomical features of shoots it is proper to examine the 10th internode of one cane each of 10 plants. It is also suitable for the purpose in view to pay attention to the even number of canes of the plants examined. Plants with 2—3 canes should be particularly avoided because in these the quantitative-anatomical features are generally more extreme. It is also advisable to select canes of medium thickness and medium internode length in order to diminish hereby — as far as possible — the individual variation.

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EFFECT OF KINETIN ON THE PIGMENT CONTENT OF BARLEY LEAVES

By

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DEPT. OF PLANT PHYSIOLOGY, LORÁND EÖTVÖS UNIVERSITY BUDAPEST

Etiolated excised barley leaves (removed from the roots) and those raised in artificial light have been floated on tap water and on a tap water solution of 10^{-4} M kinetin in a light thermostat. In the green leaves floated on tap water pigment destruction occurred after a period of 24 hours in comparison to the control (leaves kept in a kinetin solution) and this level was maintained by the kinetin afterwards. On the other hand, in the etiolated leaves kept in tap water a significant pigment destruction was noted already after three hours as the combined effect of kinetin and light had been less able to maintain pigment here than in green leaves.

Introduction

In our experiment kinetin solution was used only after the removal of the roots as for "a stitute" and in order to learn about the maintenance of pigment content relative to the excised leaves kept in tap water. It could be shown (KENDE 1964) that the yellowing of the excised leaves did not occur whenever the leaf developed roots indicating that certain root factors control the protein metabolism of leaves and consequently their pigment level as well.

6-Benzylaminopurin turns yellowing tobacco leaves green, it restores the lamellar structure of the chloroplasts too; the quantity of chlorophyll A increases the most intensively (KURSANOV 1964). Obviously kinetin affects the chlorophyll quantity of the detached leaves through protein synthesis and by diminishing protein destruction (SAHAI 1965). In our experiment we have tried to discover when kinetin stops — after isolation — the start of protein hydrolysis and the immediately following pigment destruction and whether it restores the starting state.

Material and Methods

For our experiment we have used the 7-day old leaves of the MFB barley variety raised in a light thermostat (LÁSZTITY—HORVÁTH 1965). We removed the roots of the barley plants. The excised leaves were placed in a beaker containing tap water and in a tap water solution of 10^{-4} M kinetin. They were kept in the thermostat under white light. The light intensity was 4.000 lux. Each day during 6 days the leaves were from tap water into kinetin solution put over and then examined on the 7th day. Parallel with this experiment the roots of 7-day old etiolated leaves were as well removed. Similarly to the former they were placed in water then in a kinetin solution and for the rest of the time in a light thermostat. The last day of treatment was the 5th one and the examination took place on the 6th day. In this last case we employed even a 5—8—22-hour treatment.

Each day we cut off a section from the approximately 1 cm portion of the detached leaves and placed them in water or in the kinetin solution which solutions had been changed. By this we wanted to assure the better penetration of the solutions through the fresh surfaces.

The total pigment content has been determined by FADEEL's method (1962). The experiment has been done in 8 replicates. And the gained mean results depicted on a bar graph based on microgram/mg values of fresh weight.

Results and Discussion

We have studied how long the kinetin is able to maintain or reestablish the pigment level of the control if daily, in a few hours the leaves kept in water are transferred — after the removal of roots — to a 10^{-4} M kinetin solution and

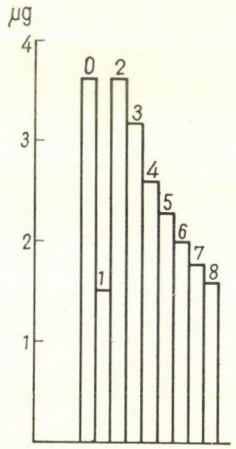

Fig. 1. Changes in the total pigment content of treated leaves isolated for 7 days and raised in light. (Calculated in microgram/mg fresh weight. Abbreviations: (0) the intact leaf at the time of setting up the experiment; (1) in water; (2) in a 10^{-4} M kinetin solution; (3) at 1 day (4) at 2 days; (5) at 3 days; (6) at 4 days; (7) at 5 days; (8) leaves placed in the kinetin solution after being kept in water for 6 days

if they are illuminated during the entire period of treatment. As controls there have been used the leaves kept in tap water and placed in the kinetin solution after the removal of their roots. The examinations took place on the 6th and 7th days following root removal.

Fig. 1 shows the changes in the pigment content of treated 7-day old barley leaves raised in light after the 7th day of isolation. Pigment destruction was greatest in the leaves kept in water (bar 1). Bar 8 contains the data on the leaves put in the kinetin solution on the 6th day. In this case kinetin had no more effect. Relative to the leaves kept in a kinetin solution (bar 2) the pigment level of the leaves kept in water has gradually reduced after a time. The 3rd and 4th bars deserve attention. It might be supposed that with the leaves being kept in water for 2 or 3 days such a reduction would not occur in the total pigment

content. It seems however that there is a very close relation between pigment destruction and protein decomposition and kinetin is unable to reverse even a one-day old decomposition process but only stagnate it. Thus it could be supposed that it is possible to obstruct protein decomposition and the pigment destruction occurring parallelly with it (KENDE 1964). Insofar as protein synthesis takes place under the effect of kinetin it is not likely that the pigment destruction should be as great as that published by SAHAI (1965). The effect of light and kinetin can be the most quickly seen in the quantitative changes of

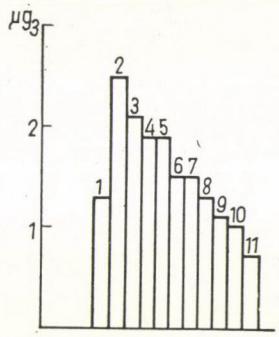

Fig. 2. Changes in the total pigment content of etiolated then illuminated leaves isolated for 6 days. (Calculated in microgram/mg fresh weight). Abbreviations: (1) in water; (2) in a 10^{-4} M kinetin solution; (3) 3 hours; (4) 5 hours; (5) 8 hours; (6) 22 hours; (7) 1 day; (8) 2 days; (9) 3 days; (10) 4 days; (11) after being kept for 5 days in water, then kinetin solution

chlorophyll A of the pigments (LÁSZTITY—HORVÁTH, HORVÁTH—LÁSZTITY 1965); thus if synthesis were also concerned it could as well be evidenced in the total pigment content. In the present experiment kinetin seems to be only an inhibitor of the decomposition following the effect of isolation.

Fig. 2 contains the results of the combined effects of light and kinetin on the etiolated leaves on the sixth day of isolation. Light and pigment together produce quite a high pigment level (bar 2). Light in itself has no effect: the decomposition can be seen (bar 1). After 3 to 5 and 8 hours of water treatment the kinetin solution has only an inhibitory effect on the once started process of decomposition. The destructive process following the effect of isolation advances and the kinetin has maintained only its particular level. Great destruction is caused in the pigment content of etiolated leaves placed in light and kept in water for two days (bar 2). It seems that here the kinetin solution even increased disintegration. The complete destruction takes place much more quickly in etiolated leaves placed in light than in green leaves. As the period of isolation increases the inhibitory role of kinetin is not so marked as in the green leaves.

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INVESTIGATION ON PLANT COLLECTION OF LUCERNE

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A plant collection of 357 varieties or progeny generations of lucerne had been tested for basic plant material of breeding at the National Institute for Agrobotany, Tápiószele, in the years 1958—1965. 176 Hungarian local varieties were included in the collection. According to the results obtained there were several entries within the collection which could be used as basic plant material for the breeding of high yielding new varieties.

Introduction

On the basis of official trials conducted for many years — in 1965 — the Agricultural Qualifying Council made the following report on certified Hungarian varieties of lucerne: ". . . generally speaking they satisfy the demands of commercial cultivation, but they fall behind the more vigorously developing West European varieties" (OMFTMI, 1966).

This valuation is due to the fact that owing to agricultural development, the lucerne is used not more than during 3 years in intensive commercial farming. The very variety put to use there, must have been of extremely vigorous development to be able to produce considerable high yields in the first year and to reach its maximal performance during the second year.

Lucerne has been and is still used by the majority of Hungarian farms generally for 4 to 5 years. The intensive plant growing of but a few state farms is so arranged that three years use of lucerne seems for them more economical. Thus the findings of the Qualifying Council are correct noting that the Hungarian varieties of lucerne as a whole "satisfy the demands of commercial cultivation."

It is likely that even in view of most intensive agricultural development Hungary will always need the "steppe" type, very drought-resistant varieties of lucerne which grow in dense stands for 4 to 5 years in the dry areas of the Great Plains with no access to irrigation water, but plant breeders must also study the production of intensive and vigorously developing varieties which suit the needs of the predictable development of cultivation.

In the 1950s the French varieties were very successful in the lucerne breeding of Europe, especially the world-famous variety *Du Puits*. This was

the first so-called intensive improved variety of lucerne more adapted to a short use of 2 to 3 years than the old and long living varieties of steppe type.

According to GYÁRFÁS (1962) in the national variety trials of 1958—1960 the French lucerne varieties *Du Puits* and *Marque Socheville* surpassed, in the first year of cultivation, all the varieties at six experimental stations while in the 3rd and 4th years their yields in hay fell below the experimental average. According to CSÁK *et al.* (1964) in the comparative yield trials of 1961—1963 the variety *Du Puits* always produced an outstanding yield in the first year, but the Hungarian varieties surpassed it in average yields of three years. Under dry and extreme climatic conditions, if irrigation is impossible, the local, undemanding varieties always assure higher yields.

According to the experiments of WOLFHARDT in Austria (PAMMER 1963, 1964, 1965) the variety *Du Puits* and the new varieties *(Liechtenstein, Florimonde,* etc.) having a similar rhythm of development certainly average higher yields in three years than the old ones. On the other hand, the Hungarian varieties have caused a disappointment with the exception of the semi-intensive variety *Mv Synalfa.* New varieties are characterized by a vigorous early development, early flowering, strong and slightly coarse stems, but beginning with the third year a considerable stand thinning and reduced productivity. According to the data from Tápiószele these varieties have reached 85 to 90 per cent of their maximum yields of the second year already in the first year of planting.

From the point of view of lucerne breeding in Hungary and considering both the foreign requirements and those of commercial production, it would be of paramount importance to launch such a breeding programme in which the best entries of the world plant collection of lucerne tested for many characteristics would be used as basic breeding material for the production of new varieties of lucerne.

In the National Institute for Agrobotany a plant collection had been established for Hungarian regional varieties, local ecotypes, and furthermore for the most important improved and regional varieties of the world. The collection being composed of a total of 357 entries of lucerne of different origin was investigated for eight years between 1958 and 1965. The results of research proved many entries being worth to be included in the breeding stock.

Material and Methods

The plant material being studied belonged to the genus *Medicago*, in particular to the species *Medicago sativa* L. and *Medicago media* Pers. The annual distribution of the number of examined entries are shown in the table on p. 399.

The seed crops produced from plots established with original seed lots in 1958 and 1959 were enough for annual replantings for four years. Thus in 1961 and 1962 in the fourth year we

	M. sativa	M. media
Seed lots planted in 1958	105	—
Seed lots planted in 1959	112	18
Seed lots planted in 1962	288	21
Seed lots planted in 1964	153	—

compared the stands of the first, second, third and fourth years. Year after year this method has provided the opportunity for determining in replicates or safely estimating the endurance of the varieties, their recovering ability, resistance, the ratio of leaves to stems, time and intensity of flowering, relative green and hay yielding ability. Thus there were 4, 3 and 2 replicates of the first, second and third years of growing, respectively.

The results of the detailed amino acid analysis of the world plant collection — because of the richness of its material — will be reported on in a separate study in the near future.

The size of plots was 6 m^2 (3×2 m), arranged in one row blocks with two standard varieties *(Bánkuti* and *Békésszentandrási)*. Method of plantings: row distance of 12 cm, with 70 seeds or sprouts per meter. Seed lots for plantings in 1962 and 1964 were taken partially from among the best entries of the previous two years and partially from new additions. That part of the collection established in these two years was planted only once using the same block arrangement, plot size and standards mentioned.

Foreign varieties have been acquired by exchange. Up to 1958, 79 and until 1961 an additional 97 progeny generations were collected from our local plant production, thus 79 entries of the collection planted in 1959 (altogether 130 plots) and 97 of the plantings of 1962 (totalling 309) were Hungarian local varieties or entries.

The distribution of foreign varieties according to country was the following:

Australia	7	Italy	14
Austria	2	Japan	1
Algeria	2	Jugoslavia	2
Argentina	15	Peru	1
Bulgaria	3	Poland	5
Czechoslovakia	27	Portugal	2
England	5	Roumania	3
FAO (mixed)	26	Soviet Union	34
France	6	Sweden	4
Germany	7	USA	11
Iran	1	Uruguay	2
Israel	3		
		Total	181

Results

Here we shall give the more important experimental results of 105 varieties planted in 1958. We shall only include the figures concerning a few noteworthy varieties from the mass of detailed data. From the collection many suitable types may be selected for crossings on account of their favourable characteristics.

Varieties showing the best winterhardiness and survival are listed in reducing order of their values:

Serial number and name of variety	Percentage of plant stands in the fourth year
50 *Békésszentandrási* (Hungary)	65—70
41 *Moravska krayova* (CSR)	65—70
48 *Sechin* (Soviet)	60—65
117 *Omskaya* (Soviet)	60—65
102 *Harkovskaya* (Soviet)	60—65
69 *Grimm* (USA)	55—60
Average of 105 varieties	32

Varieties recovering most quickly (listed in reducing order of their values):

1 *Hegyfalui*
50 *Békésszentandrási*
13 *Du Puits* (France)
48 *Sechin*
41 *Moravska krayova*
69 *Grimm*
78 *Socheville*

Varieties showing the best ratio of leaves to stems:

6 *Bánkuti*	62
69 *Grimm*	62
117 *Omskaya*	57
Four year average of 105 varieties	49.4

Varieties flowering and ripening early:

67 *Atlantic* (USA)
97 *Poltavskaya 256* (Soviet)
117 *Omskaya*
13 *Du Puits*

Varieties surpassing the average of green yields:

In the first two years:	13	*Du Puits*
In average of four years:	50	*Békésszentandrási*
	6	*Bánkuti*
	117	*Omskaya*
	41	*Moravska krayova*

Here let us present the more important experimental results of 288 varieties planted in 1962.

The Hungarian regional varieties had the best development, recovering ability and relative productivity. The following were especially excellent throughout four years (1962—1965):

138 *Tiszanagyfalui*
19 *Szomódi*
165 *Ricsei*
180 *Tiszaőrsi*
192 *Zsombói*
193 *Tiszaszigeti*

The above were excellent previously in the collection planted in 1959, especially No. 138 *Tiszanagyfalui* that has since then excelled because of its quick recovering, high leaf ratio, winter-hardiness and disease resistance. Since 1962 when a strain was selected from the original population of *Tiszanagyfalui* it has escaped the virus infection in spite of the fact that it has been grown immediately next to red clover plots very infected by complex viruses and threatened by the large aphid infestation prevailing every year in Tápiószele. This variety produces tall plants; it is a very leafy, erect type and has a characteristical "*sativa*" form. At the time of flowering about 0.5 to 1% of plants can be found carrying yellowish-white inflorescences, occasionally flowers change to greenish-purple.

The following have been found to be significantly the earliest in flowering and ripening of seed:

Hungarian local varieties:	27	*Lengyeltóti*
	35	*Koppányszántói*
	168	*Tarnamérai*
	6	*Mocsai*
Foreign varieties:	200	*San Luis 7* (USA)
	74	*Chapi*
	105	*Kubanskaya* (Soviet)

The variety *San Luis 7* was the most striking for its unusual earliness and very strong recovering ability. The collection was planted on the 11th of April, 1962 and the variety *San Luis 7* flowered already on June 28th and its completely ripened seeds could be harvested on August 23rd. Later it was demonstrated that under Hungarian conditions this variety suffered heavy stand losses during over-wintering and consequently it can be used as a crossing partner only together with repeated back-crossings and selections strictly directed for retaining the early, well recovering but winter-hardy types. Let us add, this variety later proved to be the most quickly recovering one in the entire world collection.

By way of comparison we present a few data of the varieties *Szarvasi* and *San Luis* 7.

In Table 1 it can be seen that the *San Luis 7* greatly surpasses the known variety *Szarvasi* in earliness and recovering ability, but it would practically die out in the fourth year.

We examined in detail the endurance and virus resistance of 288 varieties in their fourth year, in 1965. The density of stands of the varieties was the following:

Died out 21 varieties	7.29%
Thin stand (below 40%) 32 varieties	11.11%
Dense stand (above 50%) 235 varieties	81.60%
288 varieties	100.00%

Table 1

Comparisons between the varieties of lucerne San Louis 7 and Szarvasi
Tápiószele 1962—1964

Variety	1962		1963		1964		1965
	Time of planting	Flowering	Regeneration	Flowering	Regeneration	Flowering	Percentage of stand denseness
Szarvasi	11. IV.	4. VII.	25. III.	10. VI.	20. III.	8. VI.	60—65
San Louis 7	11. IV.	28. VI.	16. III.	13. V.	12. III.	11. V.	1—2 (8 plants per plot)

It deserves mention that the varieties *Ladak* and *Du Puits* introduced from Portugal died out, while the plots planted with seed lots produced in Tápiószele from plots established with the original seed lots of these varieties had shown dense stands even in the fourth year.

On the whole 18 per cent of the varieties were infected by virus. (We considered as infected even those entries, the plots of which had contained only 1 or 2 sick plants.) On Hungarian varieties we found only various mosaic infections, while on foreign varieties there were other symptoms in addition to mosaic infection, thus a relatively high amount (9 per cent) of crow's-nest (witch-broom) or stem dwarfness was found.

Table 2

Results of correlation calculations among seven characteristics recorded in a plant collection of 205 varieties of lucerne in 1965
Tápiószele

Characteristics	Total number of leaves	Number of leaves on branchings	Number of leaves on primary shoots	Total number of inflorescences	Number of branchings	Number of internodes on primary shoots	Height of plants
Total number of leaves	—	0.645	0.457	0.292	0.267	0.255	0.173
Number of leaves on branchings	0.645	—	0.367	0.467	0.303	0.293	0.163
Number of leaves on primary shoots	0.457	0.367	—	0.334	0.184	0.223	0.165
Total number of inflorescences	0.292	0.467	0.334	—	0.322	0.261	0.188
Number of branchings	0.267	0.303	0.184	0.322	—	0.152	0.165
Number of internodes on primary shoots	0.255	0.239	0.223	0.261	0.152	—	0.243
Plant height	0.173	0.163	0.165	0.188	0.165	0.243	—

Significance $r \leqq \pm 0.266$ ($P = 0.1\%$)
Significance $r \leqq \pm 0.204$ ($P = 1\%$)
$r \leqq \pm 0.191$ ($P = 1\%$)
$r \leqq \pm 0.183$ ($P = 10\%$)

Fig. 1. First year stand of the lucerne *Tiszanagyfalui* (TN) planted in chalky sand at Tápió-szele. 21st June 1966. In the stage of blooming. 85 cm high (Photo by Jánossy)

Fig. 2. Individual plants of flowering (TN) lucerne (Photo by Jánossy)

In the course of these investigations the local variety *Tiszanagyfalui* excelled as being perfectly virus-free.

In 1964—1965 at planting the collection containing a total of 205 varieties we used the locally improved *T—1* lucerne and the variety *Bánkuti* as standards.

The breeding of *T—1* lucerne began at Tápiószele in 1954. One of the parental populations was a mixture selected from the varieties *Socheville*

Fig. 3. Seed reproduction of *T-1* lucerne at the Cooperative Farm, Dunapataj. First year of planting flowered on 25th June (Photo by Jánossy)

(France), *Ladak* (India) and *Kuban* (USSR, from the experimental station Maikop) and allowed to flower together in the previous year, the others were the varieties *Szarvasi, Nagyszénási, Bánkuti* and *Békésszentandrási* used as crossing partners.

The distribution of the measured characteristics in the collection indicates that groups of types made up of tall, very leafy plants producing many stems can be selected from the collection.

Data obtained in 1962—1965:

64.2% of the entries at stage of flowering were 80—100 cm tall,

11.1% of the entries at stage of flowering were 101—110 cm tall,

61.9% of the plants produced 81—120 leaves per plant

Average percentage of leaf to stem ratio 63.0%
T—1 (standard) 60.0%
Bánkuti (standard) 62.0%

Fig. 4. T-1 lucerne, Dunapataj, June 25, 1966 (Photo by Jánossy)

Entries with best leaf ratio and producing many generative tillers were:

21 *Kuyawska* (Soviet)	71% leaf ratio 28 generative tillers
20 *Grimm*	68% leaf ratio 22 generative tillers
65 *F. C. 32768* (USA)	66% leaf ratio 27 generative tillers
294 *Australia*	64% leaf ratio 32 generative tillers

Correlations among seven plant characteristics were counted on 205 varieties. These characteristics were the following:

Total number of leaves
Number of leaves on branchings
Number of leaves on primary shoots
Total number of inflorescences
Number of branchings (stems)
Number of internodes on primary shoots
Height of plant

According to the significance calculations (Tables 1 and 2) there have been correlations between, for example, the number of leaves and number of inflorescences, number of branchings and number of inflorescences, number of internodes on primary shoots and height of plants, number of internodes and number of inflorescences. Therefore typical groups can be selected from the collection which in terms of green yield, earliness and seed yield surpass the standards representing the mean of Hungarian varieties.

The few outstanding entries mentioned above (Nos. 21, 20, 65 and 294) are also among those varieties suggested as basic material for breeding purposes.

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VARIA

CECEI ÉDES 3 CSEMEGEPAPRIKA

(Cece 3 Sweet Paprika)

Taxonomic category: *Capsicum annuum* L. convar. *grossum* (L.) TERPÓ provar. *ovatum* FINGERH. conc. *hungaricum* TERPÓ.

Origin: Variety improved by individual selection from the regional variety CECE (SOMOS 1966).

Beginning of breeding: 1949, Budatétény.

Breeder: ANGELI LAMBERT, Budapest.

State qualification: 1955, state certified improved variety (KAPÁS *et al.* 1965).

General characterization: Most valuable Hungarian sweet paprika variety; it brings yield in a safe and satisfactory manner; the fruit is equally suitable for market and export purposes as well as for canned production; it belongs to the earliest varieties and is suited both for early field production and for forcing purposes (KOMJÁTI 1962, KOMJÁTI—HORVÁTH 1966, SOMOS 1966).

Morphological description:

Root system: It penetrates into the soil as deep as 30—60 cm being of a thin network and forming a dense fringe-like mass (SOMOS 1966).

Shooting system: It grows as high as 35—45 cm forming close branch system. Its stalk is stiff, inclined to be ligneous with finely ribbed surface and being of lilac colour.

Foliage: Somewhat dense, of dark yellowish-green colour. Leaf-blades are egg-shaped, slightly shiny and a little curved, with pointed apex. Blades get terminated into a pedicle.

Flower: The corolla is whitish. At the 1—5 knot branches there develop generally 18—20 flowers, however, only one fourth of these become fertile. The number of flowers on the whole plant might be even 4—6fold as much as the flowers of the 1—5 knot branches (SOMOS 1966).

Fruit: Drooping, either a little stubby or of an elongated cone form; it is slightly ribbed and somewhat flattened on the sides. The apex of the fruit protrudes spout-like. Berries are generally 10 cm long and around the calyx they are about 5 cm wide. When ripe for marketing, they are yellowish-white, and when entirely ripe, the colour turns vermilion. Fruit skin is hard of about 4—4.5 mm thick, with an agreeable flavour not being hot. The number of veins is 3. The average weight of the berries is 40—55 g.

Seeds: Yellow, kidney-shaped. Thousand grain weight: 5—7 g.

Biological features:

Germinating: optimum at 25 °C. During germination the seeds take up 98—99 per cent quantity of water, as compared to the original grain-weight, during 96 hours (at 20—30 °C) (SOMOS 1966).

Vegetation period: Average time of sowing: March 16; average time of planting: May 20; the period between planting and flowering is generally 30 days; first picking: July 14. Taking into consideration different sowing dates to the first picking, the length of the vegetation period reckoned from sowing, fluctuates between 91—112 days (SOMOS 1966).

Water requirement: On different soils the transpiration coefficient is between 330—369 (SOMOS 1966). Depending on soil, the daily water consumption per plant is 250—450 g.

Disease-resistance: Rather good, the plant is resistant in general.

Inner consistency: The vitamin-C content of plants grown in greenhouse is 71.2 mg/100 g, while that of plants grown in the field is 132.5 mg/100 g (SOMOS 1966).

Agrotechnical requirements:

As to soil, this is an euryoecic plant. With irrigation it can be grown on any soil. The best yield was achieved by sowing in hotbed in the first half of March, the quantity of seed sown being 10—15 g/m^2. The most favourable spacing in the field is 350—525 cm^2 (50 + 20 × 20 or 50 + 20 × 30 cm), the seedlings being planted by two. Seedlings planted in the first half of May and being irrigated, give very good yield. Irrigating 250—400 mm (not being given more than 50 mm of water on each occasion) proved to produce abundant yield (SOMOS 1966).

Productivity: Under condition without irrigation the whole quantity of yield has been an average of 265.1 q/ha in 8 years (fluctuation: 215.1—384.9 q/ha). The early yield (up till the beginning of August) is 38—48 per cent of the entire yield (KOMJÁTI 1964).

Region of growing: It can be grown throughout the whole country.

GY. MÁNDY

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THE FIRST HUNGARIAN BOOKS ON MELON- AND WHEAT GROWING

The lifework of József Szabó

The 18th century — being the age of enlightenment in our country, too, — has produced comprehensive manuals also in agricultural literature as e.g.: Elementa rei rusticae by Lajos Mitterpacher, or that of János Nagyváthy: Szorgalmatos Mezei-Gazda (The assiduous farmer 1791). The European level of Hungarian agricultural education — the latter being started at that time — is hallmarked by names like Sámuel Tessedik and by such an institution as the Georgicon founded by Count György Festetics in Keszthely. But we must not forget authors less known by history who, however, deserve to be remembered by posterity for their experimental activities displayed in some special field and being of scientific value.

This is how we have to approach the lifework of József Szabó. The author of the book: *Cultura peponum figuris aeneis illustrata* and the *Vátzi gabona* (Corn of Vátz), was born in Csepreg on the 17th March 1742. He is the son of the very county Sopron that used to be one of this country's cultural centers throughout centuries. Situated in the west, it has always been in close touch with European civilization.

J. Szabó made his grammar school studies in Győr. In the year 1761 he became member of the Order of Jesuits. At the Nagyszombat University founded by Péter Pázmány in 1635, he studied theology and philosophy.

The question might arise where he got his knowledge of natural sciences from. According to works dealing with the history of the University,[1] the three-year philosophy faculty (being later reduced to two years) was, till 1850, of such a character that prepared students for all the other faculties granting general education. Thus, it included also the education of natural sciences. (After the mere name, it cannot be identified with the philosophy faculty of today which provides humane education.)

From the spirit of József Szabó's works the conclusion might be drawn that he must have known the work: *Oeconomica philosophia* by Márton Szentiványi who used to teach at the Nagyszombat University in the 17th century. (That author was the first to draw the attention to the importance of manuring.) The book of Szentiványi under the title: *Curiosora et selectiora variarum scientiarum miscellanea* (1689—1709) the 3rd volume of which deals with general botany,[2] was used as a compendium at the University.

We also come across factual data on J. Szabó reading works of agrarian character. In his book The Corn of Vátz he refers (pp. 74—75) to the ancient author Terentius Varro. In the 1st chapter of *Cultura peponum* . . . he mentions the didactic poem *Praedium rusticum* of the Jesuit monk Jacobus Vanierius (Jacques Vanière) that he could also read in the Hungarian translation of Dávid Baróti Szabó.

[1] A Kir. Magyar Pázmány Péter Tudományegyetem története 1635—1935. (The history of the Royal Hungarian Pázmány Péter University 1635—1935.) Budapest, 1935—38. Egyetemi Nyomda (University Press) 1—4.

[2] Rapaics, R. (1935): A természettudomány a nagyszombati egyetemen. (Natural Science at the Nagyszombat University.) Természettudományi Közlöny, **6**, 1—15.

In connection with the Nagyszombat University, it is to be mentioned that natural sciences as taught at school in the 18th century, have changed to the experimental and mathematical trend[3] both in this country and abroad. That experimental trend as adopted at the University, must have encouraged J. Szabó to devote 10 years (see the preface of *Cultura peponum!)* to the then up-to-date growing of musk-melon, and four years he dedicated to the more efficient corn experimentations (see: the preface of the Corn of Vátz !).

But let us follow József Szabó's further course of life ! After the Order of Jesuits had been suppressed, he was ordained priest to read mass and became assistant priest in a small Transdanubian town, Szekszárd. From here he was later transferred to Vác, a country-town situated along the Danube. Here he acted, in a laudable way, in the capacity of episcopal master of ceremonies. The last station of his life was Besztercebánya where he exercised the duties of the parish priest up till his death ensuing on the 2nd April, 1801.

József Szabó has contributed to Hungarian agriculture by writing two books on a special subject. The first one is the *Cultura peponum figuris aeneis illustrata* (Budae, 1790. Typis Regiae Universitatis), i.e. the growing of musk-melon illustrated with etched engravings. The book has been written in Latin; a fact partly due to the Jesuit education of the author, partly to the fact that in Hungary the Latin had been the language of sciences throughout centuries. (Fig. 1.)

As it is well known, the musk-melon is the fruit of the "puszta" (= lowland plain); it requires the glare of the sun. Because of climatic and soil conditions, many a region of Hungary is suitable for the growing of musk-melon. Early inhabitants of this country had also liked it, however, the growing of the plant had been rather primitive. In this country József Szabó's book was the first one discussing the delicious fruit. It was he who first reported on the glass-house growing of melon in Hungary. As he expounds in his preface, the aim of his book was to make people acquainted with melon growing and to make them like the qualitatively better varieties. He informs us not only about the way of growing but also about the plant itself, the varieties of musk-melon, its parasites and about the ways how to control these. Thus, it can be seen that the author has summarized his experiences and knowledge in a manifold and highly scientific treatise.

The complexity of the book can be well appreciated when glancing over the composition of the work and the headlines of the chapters:

I. *Veterum de pepone sensa, eiusque descriptio* (The views about musk-melon formed by ancient people and the description of same)
II. *Multiplicia peponum genera* (The diverse genera of musk-melon)
III. *Nomina peponum et eorum etymon* (The names of musk-melons and their origin)
IV. *Causae degenerantium peponum* (The causes of degeneration in musk-melons)
V. *Hostes peponum* (The parasites of musk-melon)
VI. *Terra peponi apta* (Soils suitable for musk-melon)
VII. *Constructio pulvini stercorarii e compagine asserum specularia sustentante* (The constructing of hot-beds with lathing that holds the glass cover)
VIII. *Pulvini stercorarii absque specularibus areae item frigidae* (Field-beds without glass cover, i.e.: cold-beds)
IX. *Praeparatio seminum* (The treatment of seeds)
X. *Pulvini stercorarii consitura* (Sowing in hot-beds)
XI. *Specularia vulgaria, et campanae vitreae* (Common glass sheets and glass bells)
XII. *Cor et rami plantarum* (The "core" and initial stems of seedlings)
XIII. *Plantatio, instrumentum adcuratae plantationi serviens, et eius usus* (Planting, the instruments and their use for accurate planting)

[3] Ibid.

XIV. *Elevatio compaginis asserum, specularia sustentantis* (The lifting of lathing that holds the glass sheets)

XV. *Sarritio, runcatio, et rigatio* (Hoeing, weeding and irrigation)

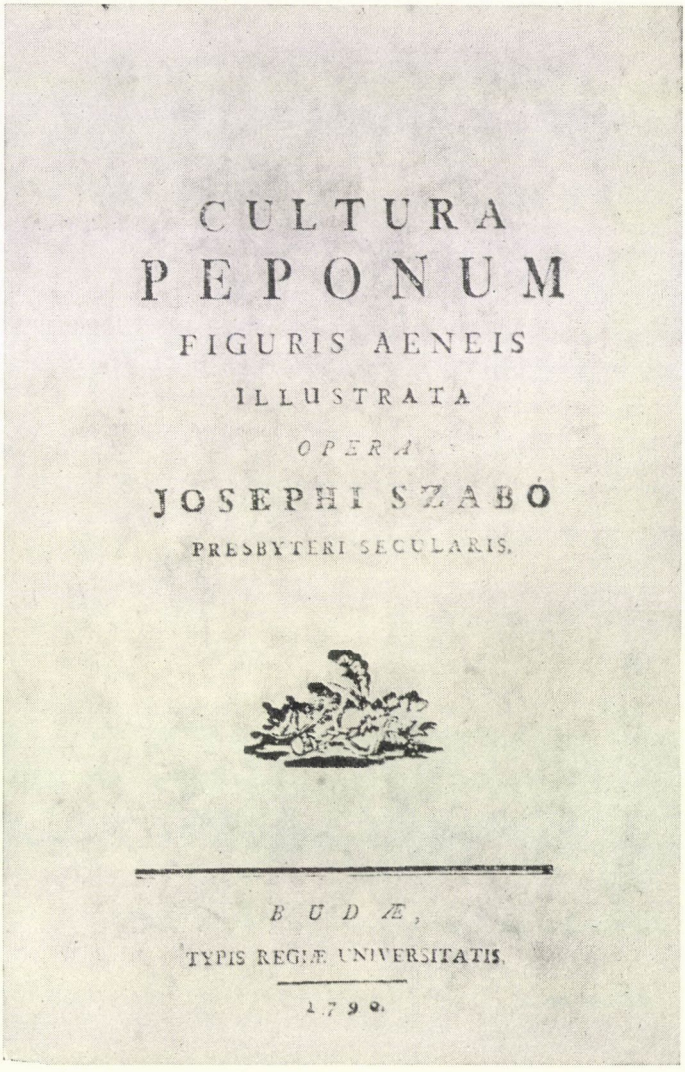
CULTURA
PEPONUM
FIGURIS AENEIS
ILLUSTRATA
OPERA
JOSEPHI SZABÓ
PRESBYTERI SECULARIS.
BUDÆ,
TYPIS REGIÆ UNIVERSITATIS.
1790.

Fig. 1. The cover of J. Szabó's book

XVI. *Signa maturi, et boni peponis* (Distinctive features of the ripe and delicious musk-melon)

XVII. *Vires peponum* (The value of musk-melon biological)

XVIII. *Usus peponum* (The usefulness of musk-melon)

The author submits the description of the following melon species: *Cantaloupe* (describing also several varieties of same), *Zatte*, *Aurantia*, *Moschatellina*, *Dormer*, *Uriana*, *Galloway*, *Doma*, *Tumlek*, *Romana*, *Callici*, *Ungarici* (tanny barked), *Turcici*, *Portugallici*, *Succado*, *Sangosa*. He makes investigations concerning the names of the melons. Thus, we not only learn

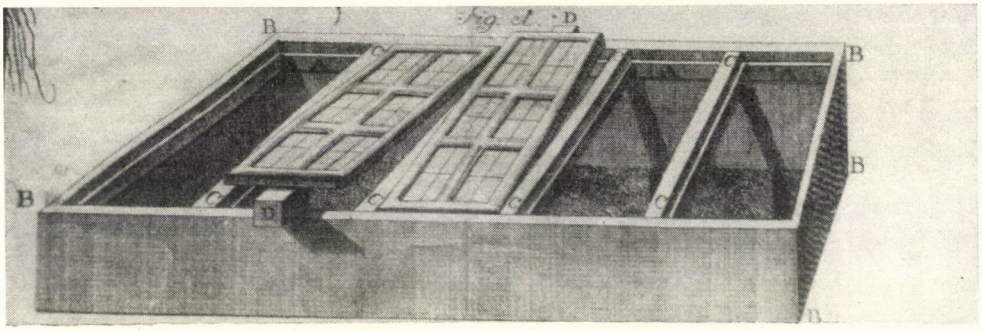

Fig. 2. Glass-covered hotbed in the book of J. Szabó

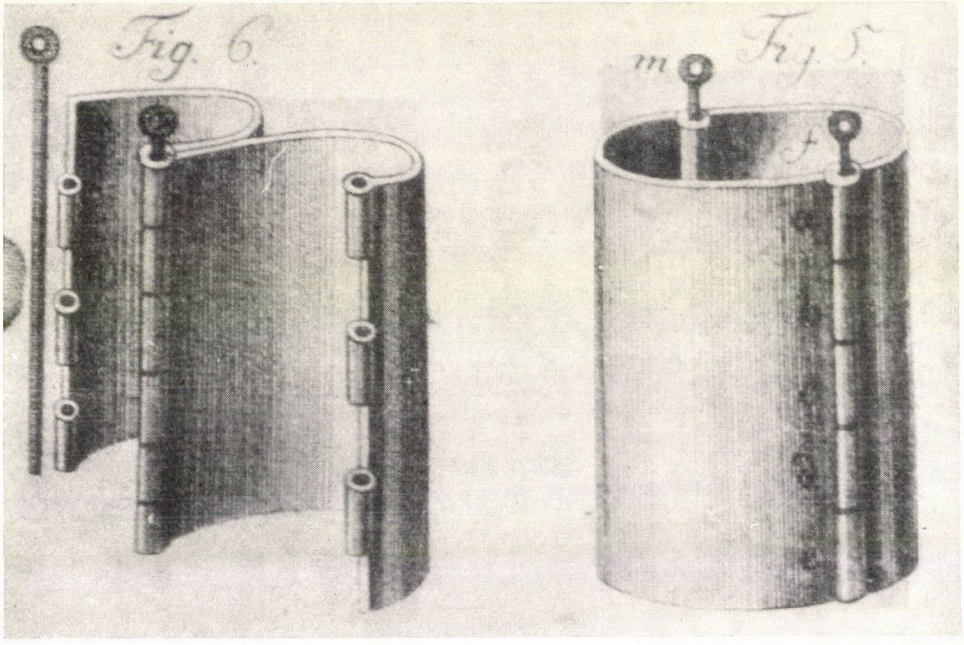

Fig. 3. Planting implement that can be taken apart

that the *Galloway* melon is round with white seeds; that, at the beginning, the seed-coat is white-ribbed but when matured, it becomes black; that it is very juicy and has green pulp, — he also tells us that the name has been given after Lord Galloway who, having travelled a lot, has also wandered over the regions of Portugal taking home the seed of the above-mentioned species. József Szabó gives a very detailed description of every phase of melon growing. From

horticultural viewpoint the chapter dealing with how to construct hot-beds, is of special importance (Fig. 2). As to promoting accurate planting, he reports on an instrument constructed by himself. That implement made of iron sheet and being a 10 inches high tube that can be taken apart (Fig. 3), renders it possible to lift up the seedlings together with the earth ball. Thus, the seedling gets into the hill with the original earth and the root is not injured on the occasion of transplanting. The method of J. Szabó can be considered a foregoer of the present way of growing seedlings in earth cuboids.

The other agricultural book of József Szabó is the Corn of Vátz (1793. Printed by Ferenc Ambró) which has been translated by Mitterpacher also into German.[4] He wrote that treatise whilst living in the episcopal palace in Vác; so it might have been that the milieu itself inspired him since the country-town Vác situated along the Danube, was one of the most important places of grain-commerce in the 18th century.[5]

In order to be able better to understand the importance of the work on grain growing of that time, it seems to be worth while dealing, in brief, with Hungarian agriculture in the 18th century. Due to the half-colonial situation of our country in the Hapsburg Empire, the developing industry of the Austrian and Bohemian provinces had found raw material as well as market mainly in Hungary. (Around 1770 87% of Hungary's export went to Austria!)[6] Up to the end of the century Hungarian export was shifted over to cereals as compared with wine-, and beef-cattle exports of previous times. In spite of increased requirements, field-production was extensive. Manuring was applied to a small extent only (manure was mostly used as fuel!). On the soil being ploughed with a primitive plough (only the earth-board and the furrow-splitter were made of iron!) very small yields could be obtained [7]

J. Szabó recognized the lagging behind of field production and the aim of the "teaching paper" with the title the Corn of Vátz, is worded as follows:

> "I submit, herewith, my trials in order to let the simple farmers try my new method of sowing; to make them like and accept it step by step so that while applying and practising the new method, they should finally get used to it."
>
> He then continues:
>
> "Oh, Lord! Do that this system be necessary all over the world but most of all, in our country so that these noble foreign nations should not think that we were ashamed of our own ways of farming; although the soil of Hungary is the most suitable for adopting that method. It would be only too rightous to take to our heart that warning."
>
> (From the preface to the Corn of Vátz.)

The methods as elaborated by him tended rather towards the increase than to the quality of yield since the excellent quality of Hungarian corn crops had been appreciated all over Europe long before. Thus, e.g., Edward Brown (1686) being charged by the English Medical Society to publish a book on his travellings of scientific character, established that the quality of Hungarian bread was high above that of any other breads.[8]

J. Szabó was of the opinion that the key of obtaining higher yield was having a thinner stand of crop. He reported on various experiments in the garden and in the field having performed these very thoughtfully in different soils and with different kinds of cereals. He supports the results of the series of experiments with figures. He submits suggestions regarding how to

[4] J. Szabó: Waitzner Getreide. Aus dem Hungarischen übersetzt von Ludwig Mitterpacher. (Waitzen, 1793. Gedr. in der Ambroischen Buchdr.)

[5] See: Belitzky, J. (1860): A magyar gabonakivitel története 1860-ig (The history of Hungarian Corn Exports till 1860). 48.

[6] Data on the book: A magyar nép története (The history of the Hungarian People). Közgazdasági és Jogi Könyvkiadó, Budapest, 1965.

[7] See: Magyarország története (The History of Hungary). Gondolat, Budapest 1964, 347.

[8] Nagy, D. (1930): A magyar búza minősége, ára és értékesítése (The quality, price and marketing of the Hungarian corn). Közgazdasági Könyvtár, Budapest, — quoted by Belitzky.

render the two sowing systems then applied in Hungary, more efficient. He makes us acquainted with the two "new-fangled methods of sowing" the essence of which could be summarized as follows:

1. In well-prepared soil that had been ploughed several times, and had been manured, pure and uniform seed should be sown.

2. On an area of 1—1 fathom (6 feet) 9—10 furrows should be made into which the seed must be put manually. That operation is described by the author in a very complicated way; the proper rhythm of the working process is based on mathematical speculations. The application of the sowing machine ("machina") is considered by him inefficient because of the clumsiness of its operation and, most probably, because of its rude construction.

3. It is stressed that the seed should be 3—4 finger deep in the soil.

4. On the quantity to be sown, the author informs us in the following manner:

> "In the counties Pest, Pilis, Neográd and several other counties the farmers have followed my method, not sowing more than one Pozsony-gauge[9] into 1200 sq. fathoms" (p. 85).

5. As to the yield, the following quotation gives us true picture:

> "In the year 1789 in the Tselőte district being half an hour afar from Vátz, in a field between the forest and the vineyards the bailiff of the landowner had 222 Pozsony gauges of oats sown and the yield amounted to 877 gauges.[10] Never before had been produced as much in that field." (The Corn of Vátz, p. 85.)

6. Author sees the advantages not only in the higher yields but also in the fact that — since less area is needed — the bad soils thus getting free, can be used for the developing of animal breeding. He also emphasizes that with the new method fuller and heavier seed can be obtained.

Looked upon with the eyes of modern man, the book contains much naivety, however, under the conditions prevailing in those days, it definitely must have meant development in the history of Hungarian corn growing.

Besides, it also meant development concerning the culture of the Hungarian language. Viz., it can be regarded a welcome change that J. Szabó has written this work of his in Hungarian. The language reforming tendency aiming at the ousting of the Latin and the German languages, had got unfolded just in the last decades of that century and by the beginning of the 19th century it spread into a national movement. The treatise of József Szabó is also a proof that the words of the contemporary writer, György Bessenyei have found good ground.

These words are as follows:

> "The main means of this country's prosperity is science. The key of science is the language; and for the majority of the population not being in the position of learning foreign languages, this should be each country's own language. To bring it to perfection, should be the chief aim of the nation that wants to have sciences spread among her own people thus trying to make them happier."[11]

M. CSERNÁK

[9] 1200 sq. fathoms = 1.0667 acres. 1 Pozsony-gauge = 100 pounds (an old and obsolete grain measure).

[10] 222 Pozsony-gauge = 22,200 pounds. 877 Pozsony-gauge = 87,700 pounds.

[11] Quotation from György Bessenyei's book: "Good Intentions towards one Hungarian Society."

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IMPORTANCE OF ELECTRON MICROSCOPY IN MOLECULAR-BIOLOGICAL RESEARCHES

While electron microscopy was producing quite a series of submicroscopic findings, biology became enriched with a new branch of science, that of the recently developed molecular biology. Though the molecular biologic application of the electron microscope does not go back long to the past, several points of contact have developed where the electron microscopic method could be made good use of by molecular biology, and the results obtained through other methods, have been complemented with proving facts.

Molecular biologic researches have mainly been rendered assistance by electron microscopy

1. in the examination of isolated macromolecules (DNA, RNA, ferritin, haemoglobin, viruses, etc.)

2. in the studies of membrane systems (plasm membranes and other cytoplasmic membranes)

3. in studying the molecular construction of different fibrillar structures (collagen, muscle).

WATSON and CRICK have created the model of the DNA molecule: the DNA model built up of indirect data corresponds to a thread-like molecule (Fig. 1). The fact that the isolated DNA molecule has been made visible with the aid of electron microscopy, is of great importance both theoretically and practically (HALL 1964).

In these pictures the DNA molecule really seems to be threadlike and its thickness is about 15—20 Å. The length of molecules cannot be established directly on the basis of the pictures, while the thickness shows good agreement with the diameter of the molecule as set up in the Watson-Crick model. On the other hand, data concerning the linear dimension of the molecules can be obtained by way of other methods. From these data we know that the length of the DNA molecule produced from the thymus, is between 0.1—1.2 microns. On the basis of theoretical calculations, the length of a DNA of 8 million molecule weight would be 4 microns. Thus, it is to be supposed that in biological structures the DNA molecules are, in some way, folded or knotted because otherwise they would not have room in the area available. The isolat-

ed DNA molecules had been submitted to numerous denaturating effects and the electron microscopic structure of the molecules was examined under such conditions. On the basis of these examinations (BARTL—BOUBLIN 1964) it has been established that the DNA coming from the native thymus being in solution can, generally, be observed as the lateral aggregate of several molecules, however, there are present separated individual DNA molecules, too. After having prepared the molecules on the carrier-films, rapid cooling and heating was performed. These effects have brough about the partial reversible denaturation of the molecule and often caused the break and fraying of the thread-molecule. The denaturalizing agents might cause the total collapse of the DNA thread-molecules, and due to this, the DNA molecules can be observed as amorph form in the electron microscopic pictures. In biological objects like e.g.

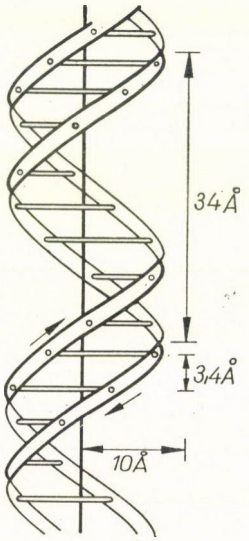

Fig. 1. On the DNA molecule structure of the Watson-Crick model. The ribose and the phosphoric acid radicles are in a double spiral: along the horizontal lines are located the purine and pyrimidine rings that are linked by hydrogen bonds. The height of a spiral is 34 Å, the distance between the base-molecules is 3.4 Å

DNA molecules or nucleoproteids, comprised in the nucleus of cells do not furnish — subsequent to fixation — very informative picture. On the other hand, in recent years in the DNA containing region of the ultrathin sections of bacteria cells fibrillar elements of 25 Å have been evinced which are supposed, to correspond to pure DNA thread-molecules since, in the bacterium cells no histon is linked to the DNA molecule that, being denatured during the fixing process, might also entail the denaturalization of the DNA molecule (SCHRELL 1964). KLEINSCHMIDT and LANG have produced from the protoplasm of the bacterium cells and with the aid of osmotic shock and high pressure, DNA thread-molecules of about 100 μ long. On these slides the length of the DNA thread-molecule can be observed in the form of a network (KLEINSCHMIDT—LANG, 1962).

The base-combination and the X-ray diffraction picture of the isolated RNA indicate them not to possess such a stiff and extensive thread as the DNA. On the other hand, in certain parts of the transfer RNA also a threadlike structure can be demonstrated and the chain-parts are linked by hydrogen bonds as well. In the course of disintegrating the Wound tumour virus isolated from plants, a separate dissociating of RNA and of the protein has been observed (BILS—HALL 1962). In the electron microscopic pictures the RNA part could be observed in

the form of a long thread, while the protein part showed a globular formation. In case of very low salt concentration the thread-like RNA molecule went on disintegrating into shorter sub-units. For the electron microscopic studies of native RNA and RNP molecules and molecule complexes, respectively, the investigation of high ribonucleic acid containing ribosomes offered itself to be an excellent possibility. It has been proved that the basophile of the cells might be in connection with the presence of ribosomes. It is also well-known that for identifying the so-called microsome fraction studied hitherto biochemically in a very thorough manner, the electron microscope has until recently, been of fundamental importance. By means of this it has been established (De Robertis 1964) that in certain cases the ribosomes are star-formed complex macromolecules with a diameter of 150 Å (Fig. 2) and having an arm-like appendage. In other cases the ribosome is elongated, its size being 150—250 Å, and from its electron dense axis more or less arms are protruding. According to some hypotheses, these extending arms

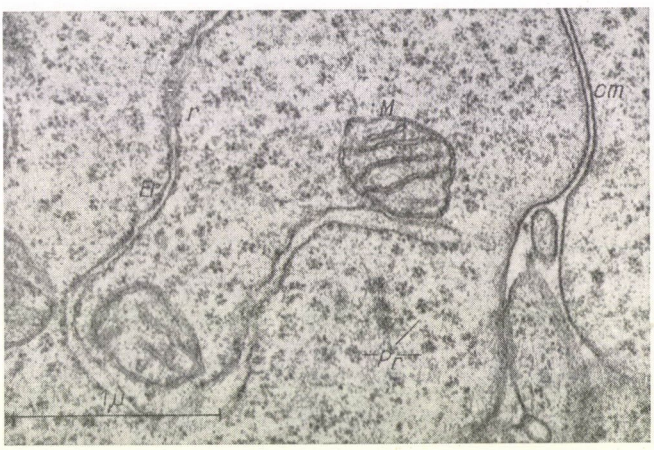

Fig. 2. Cell particle of the Shay-chloroleukemic tumor tissue. On the membrane surface of the endoplasmic reticulum (Er) the ribosomes (r) containing ribonucleoprotein, are well visible. In the cytoplasm there are numerous aggregated ribosomes (pr), the so-called polyribosomes. In the centre of the figure a mitochondrium (M) takes place the double limiting membrane of which can be well discerned from the single cell membrane (cm) × 28.000

might correspond to further morphologic and functional sub-units of the ribosome. As it is well-known, ribosomes frequently occur both in the plant- and animal cells, and are found in the cytoplasm scattered in a diffused way, or on the surface of the membrane of the endoplasmic reticulum. As to the macromolecular organization of the ribosomes, ultracentrifugal examinations have provided further data for them which have also been complemented with electron-microscopic investigations. From these examinations it becomes evident that the sedimentation coefficient of ribosomes is 80 S to which there belongs a molecule weight of 3 millions. When magnesium ion is removed, from the suspending medium the ribosomes originally settling with 80 S, will continue to decompose to fractions of 60 S and 40 S. Through electron microscopic examination of these fractions it has been established that to the fraction of lower sedimentation coefficient involves a smaller size. The importance of this fact shows itself in performing the electron microscopic identification of ribosome aggregates consisting of several ribosomes, the so-called polysomes. These latter are ribosome-aggregates linked by an RNA chain. The synthesis of polypeptides has been found to occur in such structures. Biochemical investigations have also proved that ribosome fractions with different sedimentations are apt to produce the

synthesis of proteins of different types. This is also an example to demonstrate that the morphological method of examination can render a useful assistance for biochemical proceedings. It does not seem to be our task to report on the importance and role of ribosomes in the partial processes of protein synthesis, — we only want to point out that nowadays, as a result of the above examinations, the composing of protein synthesizing models has also become feasible.

Fig. 3. A mass of virus particles in the Németh — Kellner lymphome ascites tumour cells. The virus particles frequently create regular crystal array formation (cra) in the viroplasm of which (vp) (being averagely electron dense), the primary virus particles (v) take place. These possess an electron dense nucleoid — a lighter inter-zone and a limiting zone being averagely electron dense. Part of the nucleus (N), several mitochondria (M) and a lot of free ribosomes (r) can be observed in the cell. × 28.000

Electron microscopic studies have not been confined to studying nucleic acid macromolecules only, — they have been extended also to other macromolecules being biologically important. Thus, e.g. researchers from India (SADHUKAN *et al.* 1962) have found that the haemoglobin molecules are, both in adult and new-born individuals spherical or ellipsoid formations with a diameter of 55 Å. Sometimes, these are present as aggregates in the circulating blood, too. The values measured with electron microscope are in good agreement with the X-ray diffraction data. There are also numerous molecules that turned out to have further fine-structure which,

in some cases, is invisible. In the middle of the ellipsoid molecules there is often found a "court" while on the brinks of the molecule radial indentations can be observed in the electron microscopic pictures of high resolving power. These details could not be evinced by the X-ray diffraction method. At the same time LEVIN (LEVIN 1963) — by way of uranyl acetate negative staining method — observed four subunits within the haemoglobin molecule.

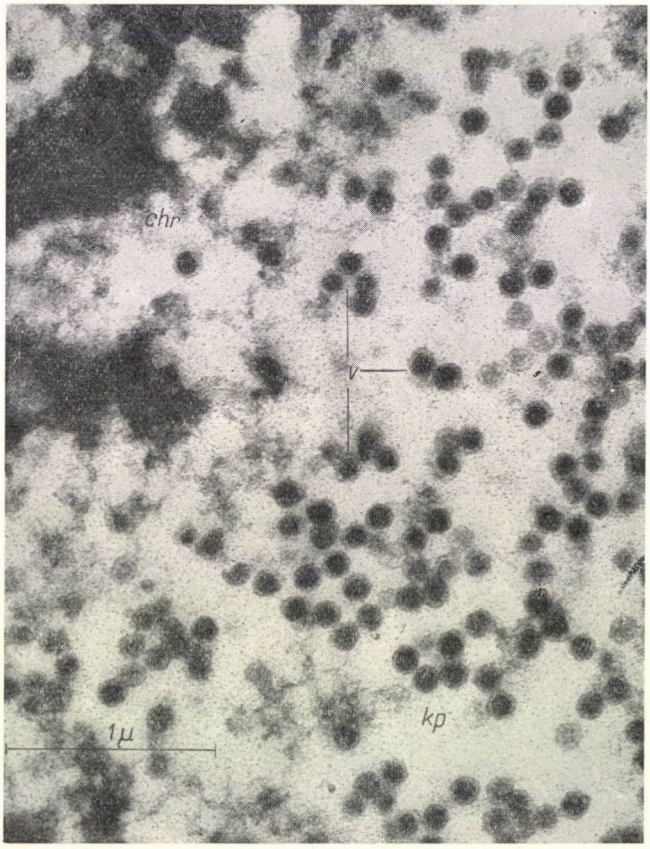

Fig. 4. Adeno-viruses (v) in the karyoplasm (Kp) of KB cells cultivated in the tissue culture. The electron dense nucleoid and the limiting membrane of the particles are well visible. Parts with high density taking place in the karyoplasm correspond to chromatine (chr). × 28.000

Experts have long been engaged also in elucidating the electron microscopic structure of ferritin and apoferritin (BRUGGEN—GRUBER 1960). The pictures taken so far, make probable the ferritin to consiste of a ferrohydroxide mycella and of the circular apoferritin shell surrounding it. By way of negative staining method it has been established that the mycellar part of the molecule settled down in the centre, can also be of different forms provided the sub-units appear in changing settlement. This might be due to the fact that there exist molecules of different type or they got into the electron microscopic picture in different orientation. The electron microscopic picture of the apoferritin molecules essentially agrees with that of the ferritin, however, the central part from which iron had been removed, is considerably lighter.

The electron microscopic examination of glutamic acid dehydrogenase of a million molecule weight, might also command interest. According to certain authors (HORNE—GREVILLE 1963), the glutamic acid dehydrogenase, in watery solution, breaks up into four fractions being 250.000 mol-weight each. In the electron microscope this fraction has proved to be a 100 Å wide and 80 Å high molecule. When staining with phosphotungstic acid, the glutamic acid dehydrogenase sub-units have turned out to be tetrahedrons, and the length of their edge measured

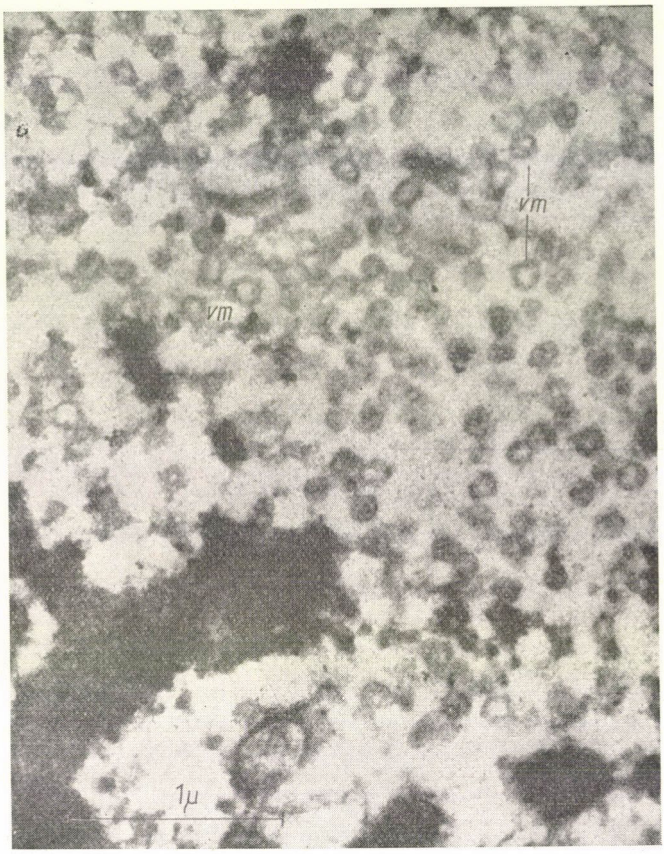

Fig. 5. DNAse digestion lasting for four hours, rendering the electron dense nucleoid of the virus particles disappeared, and only the lipoprotein-containing limiting membrane (vm) remains visible — in the form of empty circles — in the karyoplasm of KB cells. × 28.000

104 Å. From the 4 tetrahedrons the molecule form and symmetry conditions of the intact glutamic acid dehydrogenase can be constructed with great probability.

The present short paper does not render it possible to report also on the electron microscopic structure of numerous other isolated macromolecules hitherto thoroughly studied like e.g. the cytochromes, haemocyanine, phospholipids, etc. The viruses might be also included in the group of isolated macromolecules. In fact, electron microscopic examinations have furnished the first reliable data on the size, shape and fine-structure peculiarities of viruses. As to identifying virus particles, the problem showed itself not so much in the small size but rather in the insuffi-

cient contrast of the particles (the diameter of the viruses is much more larger than the resolving power of the electron microscope). For enhancing the contrast of biological materials, several methods have been elaborated. Thus, e.g., HALL has successfully applied, both the phosphotungstic acid giving the positive contrast and the uranyl acetate securing the negative contrast as for enhancing the virus particles responsible for the bushy growth of tomato (HALL 1964). It was by applying the same methods that HUXLEY revealed the "tubular structure" of tobacco mosaic virus (HUXLEY 1957). With a view to identifying the virus particles, the bedding into synthetic resin, viz. the introduction of ultrathin cutting technique meant great improvement. By way of these methods it became possible to evince, in situ, the virus particles in the nucleus, cytoplasm of different neoplasms and also in the intercellular space. In ultrathin sections the virus particles are mostly observed in groups (Fig. 3) forming crystal array. That regular arrangement is — for identifying the virus particles — a fundamental morphological requirement. In general, it is characteristic of the ultrastructure of viruses to have a highly electron dense nucleoide surrounded by a light electron-permeable court and membrane. The virus particles can usually be observed being embedded in an electron dense viroplasm. For the classification of viruses and for the determination of their biological peculiarities a thorough knowledge of their chemical structure is needed. The application of water-soluble embedding materials (glycolmetakrylate) made it possible to perform enzyme digestion also on ultrathin sections. The DNA-se and RNA-se applied consecutively and the pepsin digestion furnished proper information on the chemical composition and classification of the unknown virus. Fig. 4 shows the nucleus of KB-cells obtained from tissue culture, 5 days after the12 adenovirus infection. The electron dense nucleoid and limiting membrane of the virus particles are utterly visible. After digesting with 0.1% DNAse for four hours, the electron dense nucleoid disappeared and only the membrane of the virus particle remained (Fig. 5). That examination (LAPIS 1965) has proved the nucleoid of the 12 adenovirus to contain DNA its limiting membrane being — however — of protein nature for it disappears only after the pepsin digestion. In that latter case the electron dense nucleoide is remaining unchanged. Of course, the electron microscopic examination cannot furnish but a few data for the accurate knowledge of a kind of virus. Therefore, besides these examinations, serologic and other biological examinations are also of fundamental importance. Concerning the electron microscopic examinations dealing with the molecular organization of lamellar and fibrous biological ultrastructures, it might be observed that the lamellar or membraneous structures i.e. cell-membrane and its special formations, the mitochondria, Golgi apparatus and endoplasmic reticulum are extensively studied and explored fields of submicroscopic cell-morphology. We are by these data (ROBERTSON 1958) informed that the fundamental basis of the membrane structure is the so-called "unit membrane", each consisting of 20 Å-wide dense layer and the 35 Å lighter interspace. Electron microscopic examinations have thus confirmed the earlier hypotheses according to which the cell-membrane comes into being as a result of the special linking of lipoid and protein molecules (Fig. 6). The two dense lines of the unit membrane are composed of the polypeptide chain of the protein molecule and the hydrophile part of the lipoid molecule. The lighter 35 Å interzone between the two electron dense lines corresponds to the layer of the hydrophob pole of the lipoid molecules, being oriental opposite each other. Of course, this diagram for the molecular arrangement of the unit membrane can be considered as a basis only for studying membrane structures developed to perform other special functions, and further investigations are needed for elucidating the real molecular organization of a given membrane structure.

Among the biological materials of fibrous structure the objects best studied electron microscopically, are the collagen and the muscle fibre. The examinations have proved the collagen fibril to dispose of well-defined submicroscopic striates. The distance of the striates is 650 Å (Fig. 7). However, on the basis of these data no conclusions could be made regarding the construction of the collagen molecule. Biochemical examinations have soon made evident that the

native macromolecule extracted from different connective tissues, corresponds to the tropocollagen. In solution these are long filamentary molecules the size of which is 14×2.900 Å. X-ray diffraction examinations have revealed that each tropocollagen molecule consists of three polypeptid chains of identical length and being coiled helically side by side. That so-called alpha helix macromolecular organization is characteristic not only of the collagen structure protein but also of the formation of several other fibrillar protein molecules. Among them the best-known are the fibrinogen, the fibrin and the silk-protein. The electron microscopic structure of the latter has also been made possible to identify. If the polypeptide chains get rolled up, globular proteins come into being. Such is e.g. the myoglobin consisting of a single polypeptide chain and the previously mentioned haemoglobin built up of four polypeptide chains. The electron microscopic pictures made by way of negative staining process (HODGE 1958) have proved the above described concept referring to the macromolecular organization of collagen. With the

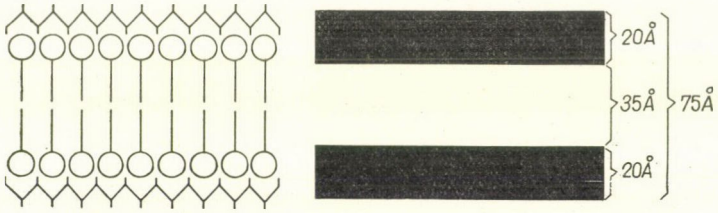

Fig. 6. Schematic sketch of the molecular construction of the plasm-membrane. The zigzag lines demonstrate the polypeptide layers of the membrane. Within this take place the lipid molecules, the hydrophile end of which is shown by a ring while the hydrophobe pole by a rod. In electron microscopic pictures the polypeptide chain and the hydrophile part of the lipoid molecule can be observed in the form of an electron dense line (in case of osmium-fixation these parts are highly osmiophile). The diameter of this layer is 20 Å. The inner layer of the plasm-membrane is of similar construction. Between the two electron dense layers there exists a light interspace (is) of 35 Å width. On the basis of Robertson's investigations, the unit membrane of the cellular membrane is 75 Å wide

aid of this, it became known that the SLS (Segment Long Spacing) tropocollagen was actually a crystallic form in which the macromolecules that had alpha helix construction, were present in a parallel arrangement. On the other hand, in the FLS (Fibrosous Long Spacing) collagen fibril alpha helix macromolecules are arranged antiparallel, and in the native collagen fibril, as compared to one another, the alpha helix protein molecules forming the protofilament, are shifted by about one fourth of the length of molecule.

From molecular biologic viewpoint, the electron microscopic examinations dealing with macromolecular construction of the striated muscle, are also very interesting. In Hungary GUBA et al. (GUBA 1966) have come to results being also of international importance. It is well-known that biochemists had long ago isolated the structure proteins: myosin, actin and tropomyosin and studied very thoroughly their physiochemical properties. The form of the electron microscopically prepared myosin is rod-like (GUBA 1965) terminating on one end in a spherical form. The peculiarity of these molecules is their getting aggregated through which the molecules are linked to one another forming long filaments. After slight trypsin digestion the myosin decomposes into further, so-called H and L meromyosin. The H meromyosin is the globular part of the myosin and corresponds to the loose coil of the polypeptide chains while the L metromyosin respresents the rod-like part of the molecule and consists of three polypeptide chains being rolled up in alpha helix manner. A characteristic feature of actin is to occur both in globular and fibrillar form. In electron microscopic pictures F actin turned out to be of

filamentary structure (HANSON—LÖWY 1962) while, the macromolecular structure of tropomyosin was shown network-like (GUBA 1965). The new muscle protein isolated by GUBA et al., the fibrillin that forms, according to authors, the basic filamentar structure of myofibril, seemed as well to be of net-like formation in electron microscopic examinations performed at macromolecular level. It is not yet decided with which structure protein the primary and secundary protofilaments of the electron microscopic picture can be identified. According to HUXLEY (HUXLEY—HANSON 1960) the isolated primary filaments show strong similarity to the myosin aggregate while the secundary filaments can be identified with the F actin.

Electron microscopy reveals not only the morphological peculiarities of normal macromolecular structures, — it has proved to be useful in getting acquainted with the morphological

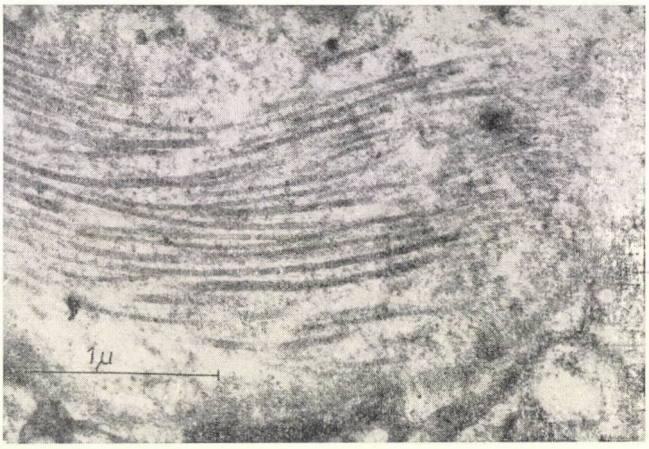

Fig. 7. Collagen fibrils in the connective tissue substance of the rat adrenal. The submicroscopic picture shows the fibrils are striated. The distance between the high density stripes is 650 Å. This corresponds to the main period of collagen fibre. Within this, further fine subperiods can be observed. × 28.000

manifestation of pathologic lesions occurring in them. There is not possible to discuss in this paper the results obtained in this field even on sporadic examples, however, it might be sufficient to mention the fact that the Journal of Molecular Pathology has now issued its 4th Volume.

Electron microscopy is also useful in studying, not only at subcellular but occasionally, at macromolecular level as well, the uptake of drugs by the cells, their intercellular transport and effect on the cells. The papers published in the periodical now being launched: Journal of Molecular Pharmacology, also seem to prove this.

In the present report not aiming at completeness, we only wanted to show, on examples taken at random, the contribution of electron microscopy to elucidate molecular biological problems. It is hoped that in future electron microscopic preparative technique will solve the problem concerning the synthetic products connected with biological dryıng up of substances, and equally with the phase contrast microscope there will be a possibility also for "in vivo" examination of life processes at molecular level.

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CALF BREEDING EXPERIMENT WITH "STIMULEX"

In Hungary no report refers to *Stimulex*, it has not yet been tested. The preparate is still a novelty even in the wide world, and in the literature only few references and experiences can be found that have been described by veterinaries and experts in Denmark and Sweden.

In Sweden O. *Damberg* has applicated *Stimulex* succesfully, against disturbances in rumen function and in ketonaemia.

In Denmark K. *Løje* gave *Stimulex* in chronic tympanitis of Jersey-cows, when any other therapy had not prevented recidivas, and milk production and body weight had fallen. *Stimulex* stopped further recidivas, the cows' health restituted.

The same expert rationed the preparate to Danish red cows, in intense diarrhoea chronic bloat and loss of appetite. After four days dosage the cows were restituted and consumed their food with normal appetite.

To further 18 Jersey cows with puerperal endometritis also *Stimulex* was given, when intense antibiotic therapy had led to anorexia. Within two days — with only one exeption of them recovered and their milk production restored.

Twenty Hungarian-spotted 3—4 week old calves obtained from the cooperative "Alkotmány" (Komárom county) have served as experimental animals.

The calves were divided into two lots. The experimental group consisted of 5 bulls and 5 heifers (from the latter, one discarded for pneumonia). Into the control group 6 bulls and 4 heifers were selected.

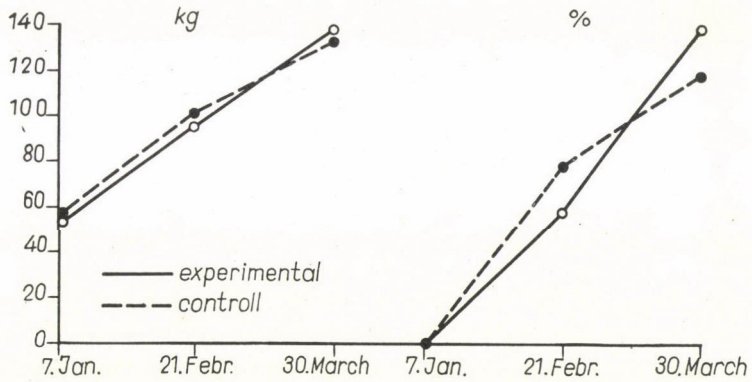

Fig. 1. Weight gain of groups

Although body weight in both groups varied with certain modest ranges, the means of body weight values did not differ essentially:

experimental group ..... 57.7 kg mean value
control group ..... 59.3 kg mean value

Although the control mean is evidently higher, still better balance of grouping from livestock given was not realizable.

Stimulex was weighed practically into paper-bags, 10 gms into each, and mixed thoroughly into the morning and evening milk ration of each individual before feeding.

Calves of both groups took the same regime. During the experimental period their daily ratio was as follows:

standardized fodder for calves ..... 1 kg
hay of trefoil ..... 1 kg
TBK-40 (milk substitute) ..... 0.7 kg

Weight gain was controlled at the beginning of the experiment, then 45 days after, when dosage of *Stimulex* had ended and finally after further 37 days. This weighing was carried out to establish the existence and the rate of an eventual ulterior effect of *Stimulex* influencing the animals' development and health. The values obtained did prove this supposition.

Stimulex is made mainly of rumen extract to which various amino acids and peptides are added, supplemented with phosphorus and cobalt salts in order to eliminate the undesirably altered bacterial fermentation in the rumen and to restore the normal digestive function.

Although initial bodyweight in experimental group was less than that in controls and this difference even increased insignificantly, at the end of 82 days of *Stimulex* dosage, weight gain in experimental group could be established:

Table 1

The bodyweight gain

Calf No. sex	Bodyweight			Weight gain					
	data of weighing			1—45 days total			1—82 days total		
	7.1. kg	21.2. kg	30.3. kg	g/a+	kg	%	g/a+	kg	%
Experimental group:									
158. ♂	76	125	165	1090	49	64.5	1085	89	117
160. ♂	69	110	165	912	41	59.5	1171	96	139
68. ♀	62	99	140	822	37	59.8	951	78	126
87. ♂	65	103	150	843	38	58.5	1037	85	131
208. ♀	53	87	135	755	34	64.2	1000	82	154
43. ♂	41	75	115	755	34	83.0	902	74	180
117. ♂	51	81	110	655	30	59.0	720	59	116
202. ♀	52	87	130	775	35	67.0	951	78	150
259. ♀	50	95	135	1000	45	90.0	976	80	160
Total	519	862	1245		343			721	
mean of group	57.7	95.8	137.8	850	38.1	59.5	977	80.1	138.9
mean ♂	60.4	98.8	141.0	853	38.4	63.6	983	80.6	134.0
mean ♀	54.2	92.0	133.8	838	37.8	69.8	970	79.5	146.0
Deviation				± 5.96 kg			±10.31 kg		
				± 15.6%			±12.85%		
Controll group:									
206. ♂	72	102	130	665	30	41.8	707	58	80
124. ♂	69	113	155	975	44	63.5	1049	86	124
161. ♀	62	97	140	775	35	56.5	951	78	126
192. ♂	68	117	160	1090	49	72.0	1122	92	135
195. ♀	56	95	125	865	39	69.5	841	69	123
259. ♂	47	88	125	910	41	87.0	951	78	166
135. ♂	58	104	140	1022	46	79.2	1000	82	142
128. ♀	63	101	140	843	38	60.5	939	77	122
137. ♀	50	87	130	822	37	73.5	976	80	160
187. ♂	48	98	117	1110	50	104.0	841	69	144
Total	593	1002	1362		409			769	
mean of group	59.3	100.2	136.2	910	40.9	68.8	938	76.9	129.7
mean ♂	60.3	103.6	137.8	962	43.3	72.0	945	77.5	128.5
mean ♀	57.8	94.0	133.7	826	37.3	65.0	927	76.0	131.4
Deviation				± 6.37 kg			± 9.6 kg		
				± 15.6%			±12.5%		

	Averages of						
	body weight			weight gain during			
	initial	at the end of dosage	at the end of exp.	1—45 days		1—82 days	
	kg	kg	kg	kg	%	kg	%
exp. group	57.66	95.77	137.77	38.1	59.5	80.1	138.9
control group	59.30	100.20	136.20	40.9	68.8	76.9	129.7

Although, weight gains at 45 days (at the end of *Stimulex* feeding) showed faintly higher values in controls, the weighing on the 82nd day of the experimental period pointed 4.1 per cent gain for the experimentals' benefit. In addition, from these values 7.1 per cent positive difference could be calculated as percentual weight gain of the experimentals, less than the deviation.

Analysed statistically:

1—45 days		1—82 days	
of experimental period			
experimental group	control group	experimental group	control group
$X_1 = 38.11$	$X_2 = 40.90$	$X_1 = 80.10$	$X_2 = 76.90$
$n_1 = 9$	$n_2 = 10$	$n_1 = 9$	$n_2 = 10$
$s_1 = \pm 5.96$ kgs	$s_2 = \pm 6.37$ kgs	$s_1 = \pm 10.31$ kgs	$s_2 = \pm 9.60$ kgs
$\pm 15.60\%$	15.60%	$\pm 12.85\%$	$\pm 12.50\%$
$t = 0.93$		$t = 0.702$	
P % 5		P % 5	

Notwithstanding that, according to the mathematical analysis, the positive effect of *Stimulex* on weight gain increase has not been proved to be statistically significant, the tendency of *Stimulex* to enforce the vigour of development is clearly remarkable.

Observations and opinion of experts and breeders of cooperative were not unimportant either. The author himself has frequently checked the livestock, and stated, that the tranquil behaviour of the experimental individuals was noticeable during all the length of experiment, they fed with appetite, their fur was smoothened and shined, excreted faintly consistent faeces during some days after the initial intake of the material. However, their water consumption was higher in relation of the controls. No diarrhoeas occurred in the experimentals while two falls were constated among the controls.

In addition to these twenty calves treated with *Stimulex* experimentally, further four animals from various folds of stall suffering from diarrhoea were given *Stimulex*. Three among them quickly recovered soon after two ratios, in only one the diarrhoea did persisted. Resisting against a thorough medical treatment of the breeder (chloramphenicole, oxytetracycline, chamomille-infusum, "Septiol"), this condition finally led to slaughter. At autopsy, inflammation of gastrointestinal tract could be established.

Perhaps it is worth mentioning that bull and heifer No 259 twin double was equally ranged into both groups of trial. Although the heifer was put among the experimental animals

and the bull among the untreated controls, the heifer showed 80.0 kgs weight gain, whereas the bull only 78.0 kgs. It is commonly known, that the vigour in weight gain of bulls is usually stronger.

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GENETICAL INFLUENCE OF METEOROLOGICAL FACTORS IN CROP STANDS

The action of environmental factors and particularly of the weather on plants was studied by many authors both from genetical and other aspects. In literature in connection with the genetical impact of meteorological factors statements can be found only in individual respect but hardly as concerns influences on stands. This position truly reflects the usual genetical view evaluating the processes and environmental reciprocities of heredity only in individual relationship. It is due to this fact that such genetical actions of meteorological conditions which become only effective in stands are reflected on the individual which in this respect is rejected by many authors and rightly so because in fact no changes in the stands can be expected from the individual.

The effects of the environmental factors do not generally change the inheritance of the individuals but depending on it modify a number of features to a lesser or greater degree (modifications). These modifications are not inherited but increase the diversity of the individuals. The environment may have, however, effects favouring the spontaneous change of the inheritance or may be the explicit causes of various changes. Particularly the extreme meteorological effects may elicit heritable changes (MÜNTZING 1958).

The frequency of the spontaneous changes arising on the individuals is, however, very slight; they appear generally to a proportion of 10^{-4}—10^{-6} (BÁLINT 1964). According to MÜNTZING (1958) the majority of the changes evolved are of low viability and not competitive. So most of them disappear from the stands. Their subsistence is also decreased by the possibility that they may change back to the ground form.

In the heritable changes becoming effective individually the chances of wild and cultivated plants are substantially different. While the wild plants grow scattered in most cases and to very wide spaces, such is ensured only to some ornamental plants; otherwise the majority of cultivated plants is living in masses and in dense stands. In the first category the changed individual is able to freely transmit its new characters by heredity and if it produces otherwise viable progeny the changed form may spread and even develop a considerable area. In the stands of the cultivated plants, however, the changed individuals owing to their low number get lost, they hardly reach the majority in the stand and in most cases are even thrust in the background and if otherwise their viability is poor they disappear without leaving a trace.

In the course of my ecological investigation I have realized that the action of the environment and particularly of the weather conditions on the stands of cultivated plants is genetically much more significant than the effect induced on the individual. Moreover, while the individual genetical effect is only of very low frequency, the impact on the stand is always accompanied by genetical consequences. In the light of my experience let us examine which way the genetical effect of the weather (or of other groups of environmental conditions) manifests itself in the stand.

The behaviour of the individuals in the stands toward a meteorological period is different. The effects are more or less favourable or unfavourable for the individuals. The mode of the relationship of the individual depends on its inheritance and has qualitatively three possibilities.

1. the individual as a result of its very different inheritance cannot tolerate the meteorological impact and dies (especially on the appearance of exceedingly extreme meteorological effect);

2. though the individual may tolerate the meteorological influences but lags behind in development, the formation of its body and its productivity considerably decrease, the biological value of its seed is low;

3. the meteorological effects agree with the inheritance of the individual, its development is rapid and rhythmical, the formation of its body vigorous, its productivity outstanding, the biological value of its seed excellent.

These three categories have only a general validity. According to COOPER (1965) in the individuals the variation of most genetically examined adaptive features is continuous and, as it can be expected, they are polygenically regulated. Consequently among the types referred to a continuous transition is more probable in the stand and a substantial amplitude of the ecological variations is as well possible.

Therefore, a meteorological period in the stand of any plant rearranges the genetical composition, dropping out those being unable to adapt themselves, driving out those which poorly propagate and promoting the domination of those of high adaptation. This rearrangement is the more extreme the more unfavourable the meteorological period is for a higher number of individuals, thus accelerating the genetical transformation of the population. There is no doubt that such natural selection results in a considerable "impoverishment" of the variation of the stand and favours the development of an exotype (land race, local variety).

I recognized the intensive genetical impact of the meteorological factors in the course of my phenoecological investigations. In all phenoecological examinations conducted up to now I have regularly made the experience that the individual manifestation of the developmental phenomena of plants in various stands and of their numerous morphological and physiological characters is in close connection with the influence of meteorological and other ecological factors having been effective during the vegetation period. The measure of these effects is different according to the varieties and various conditions. It was not difficult to establish from the facts that in their ecological relationship not only the varieties but the individuals were not either uniform within the stand of the same variety. The different behaviour can be traced back, as already referred to, to genetical causes.

The behaviour of plants (and other living beings), toward meteorological and other ecological factors is always determined by many genetical factors, as well as in most high-bred stands and in pure lines the genotypical variability of the individuals is considerable. Thus the stands are populations of different ecological reaction out of which the different ecological effects induce individual reactions of different degree and distribution. The favourable conditions stimulate the development in the majority of individuals but only slightly inhibit the development of individuals in adequate genetical composition. As a result the stand will be highly uniform in its developmental rhythm and in the appearance of its individuals and the individual spreading of its features will be distributed within narrow limits. As a contrast the unfavourable conditions slow down the development of many individuals in the stand, prejudicially influence the manifestation of characters and highly increase the variation of the developmental rhythm. This is why in such cases the *individual amplitude* (the degree of individual spreading) substantially increases and the composition of the stand biologically and practically deteriorates (Fig. 1).

From these it follows that the ecological reaction will become effective according to the genetical composition of the individuals of the stands. When studying the mode of reaction of the stand in a proper ecological sequence we shall obtain in conformity with the given genetical conditions a distribution according to the scatter diagram (Fig. 2) from which the variety of suitable composition and the most favourable condition can always be selected.

According to the experimental data of a number of authors the influence of the new environment in which the most important group of factors is the weather induces, in a few years, remarkable changes in the stand (BENNETT 1965). This phenomenon was observed also by myself in connection with oat varieties. I have set two varieties of oat, the Hungarian *Székács 8* and the Polish *Bialy Mazur* together with other varieties with a difference of 8 years on two occasions into an ecological experiment. When examining the ecological character of the varieties interesting differences were found between the two experiments (MÁNDY 1960,

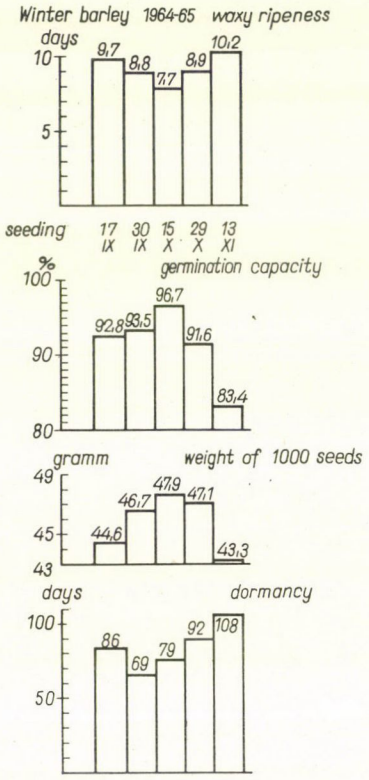

Fig. 1. Connection of the individual amplitude of the waxen ripening of winter barleys (above) with germinative capacity (%) thousand grain weight (g) and developments of the length of embryo dormancy in the ecological sequence established with the delayed sowing technique (on the horizontal axis the seeding dates). Waxen ripeness, germinative capacity and thousand grain weight are the means of the same 10 varieties while the length of embryo dormancy indicates the mean value of four varieties among them. The shortest amplitude of waxen ripeness (the least individual scattering in the stands) coincides with the highest germinative capacity, thousand grain weight and shorter embryo dormancy. Original

MÁNDY—KOVÁCS 1964). It appeared that during this period a change of opposite trend had developed in the two varieties (Fig. 3). The oat *Székács 8* with the transfer of its varietal maintenance (to Magyaróvár) had lost its excellent adaptability while *Bialy Mazur* transferred into Hungary from its native country of cooler and wetter climate had become remarkably adaptive.

Darwin from the natural factors of selection stresses the struggle for life "within the species" which has been recently challenged by several authors (Lyssenko *et al.*). *Darwin*

emphasizes the competion within the species when stating that "the struggle for life is most severe among the individuals and variants of the identical species" (cit. BÁLINT 1964). Such struggle cannot be imagined in any population of the same species or among populations. The individuals do not "compete" with each other but under the influence of the environmental conditions acting on the stands (especially the weather) in conformity with their inheritance develop and propagate poorly or perhaps upon appearance of extreme factors are destroyed. Selection in them has been conducted by the ecological effect. It is therefore important to

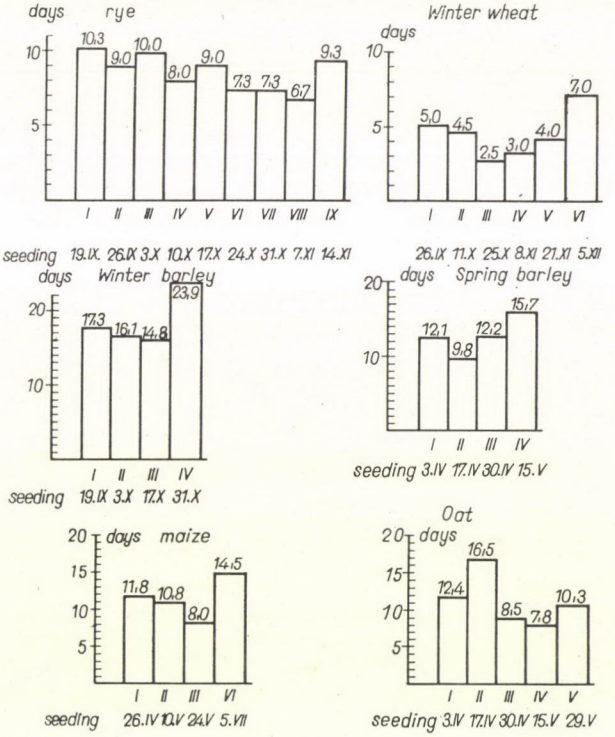

Fig. 2. Individual amplitudes of earing (rye, winter wheat, winter barley, summer barley), panicle emergence (oat) and male inflorescence (maize) of various cereals in the ecological sequence established with delayed sowing technique (horizontal axis indicating the seeding dates). The vertical axis and the numbers above the columns indicate the amplitude in days corresponding to the seeding dates on the varietal average. Data originating from the experiments of the author conducted in Tápiószele

attach in future ever more attention to the genetical effect of the ecological conditions which always becomes effective in the stand of plants.

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Prepared by the National Institute of Agricultural Botany, Tápiószele.

GY. MÁNDY

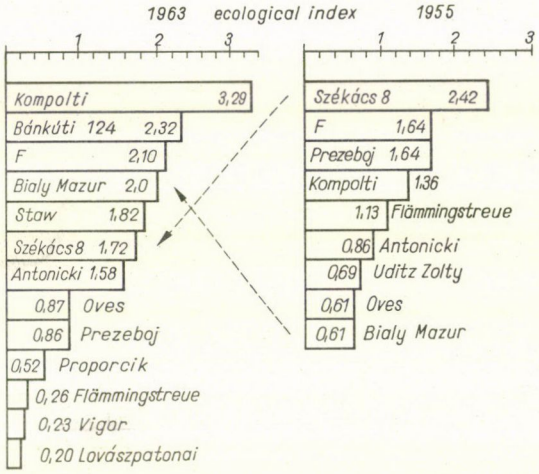

Fig. 3. Ecological ranking of oat varieties in two experiments (Vácrátót 1955 and Tápiószele 1963). The horizontal axis indicates the measure of the "ecological index" (the figures written on the columns) while the vertical axis the varietal ranking according to diminishing values, the increasing ecological sensibility. In the order of ranking above the most adaptable, below the most sensitive varieties. The arrows indicate the change of the ecological character of the two varieties. Original

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DATA ON THE DIFFERENTIATION OF THE MUCILAGE CAVITIES IN ALTHAEA ROSEA (L.) CAV.

In our previous work we have mainly studied the development of the lysigenous formation of excretion holders (DÁNOS—JUHÁSZ 1966, JUHÁSZ—DÁNOS 1966) and have been led to the conclusion that the excretion holding system built up by the combination of cells or whole cell-groups, is a more frequent phenomenon in the plant kingdom than it was thought before (FREY—WYSSLING 1935, SPERLICH 1939, GUTTENBERG 1955, KAUSSMANN 1963, KISSER 1958, etc.).

Of the very diversified metabolic and conversion products, mucilage and the formation of cells and cavities containing it were mainly studied. In the works published by the end of the last century and in the 20th century (FRANK 1866, LEUTERBACH 1889, WALLICZEK 1893,

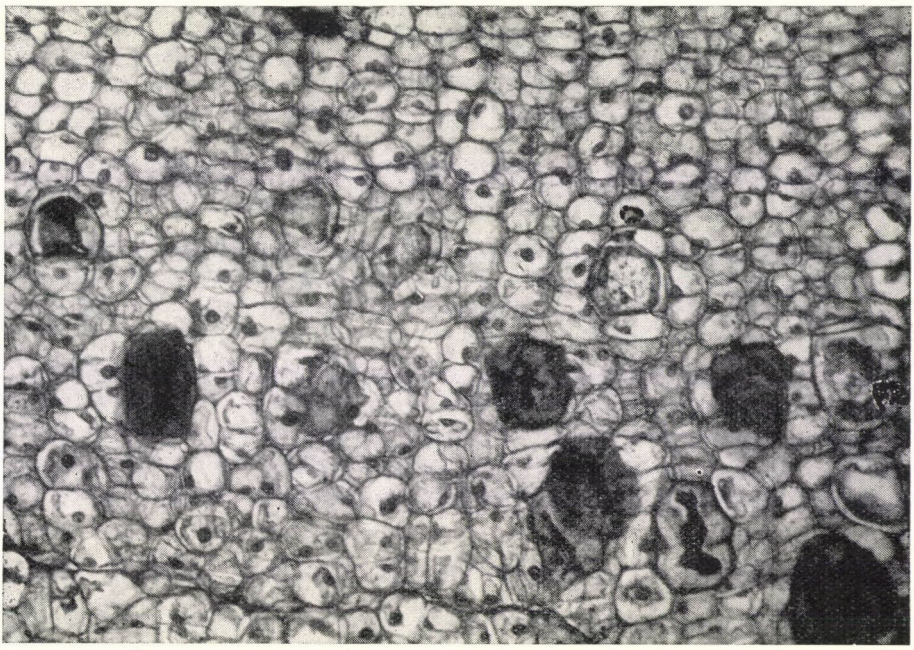

Fig. 1. Part of the vertical section of the vegetative tip with differentiating mucilage cavities; × 80

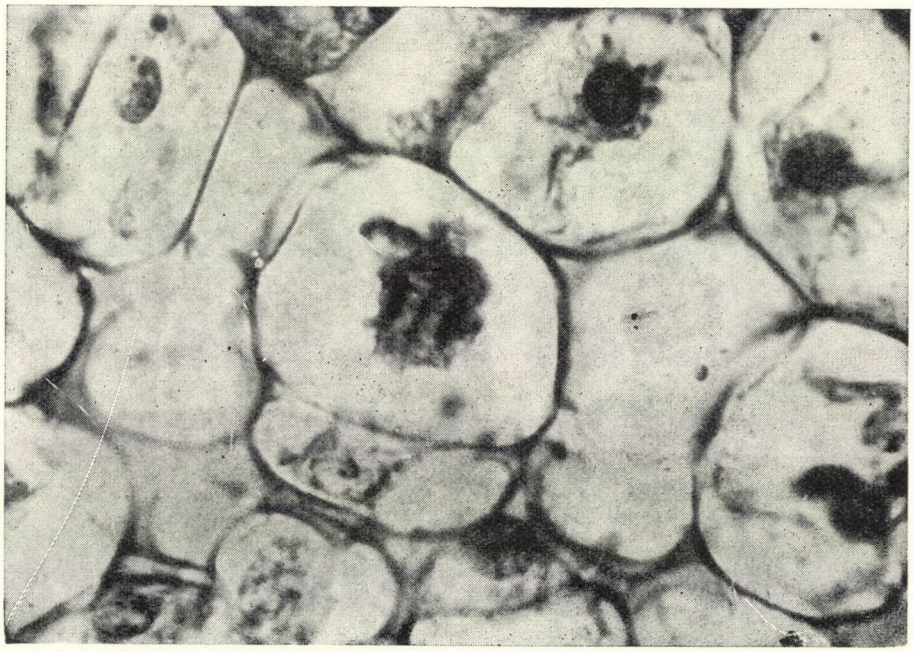

Fig. 2. Dividing nucleus of the differentiating intercellular with nuclear spindles and phragmoplasts being well visible; × 180

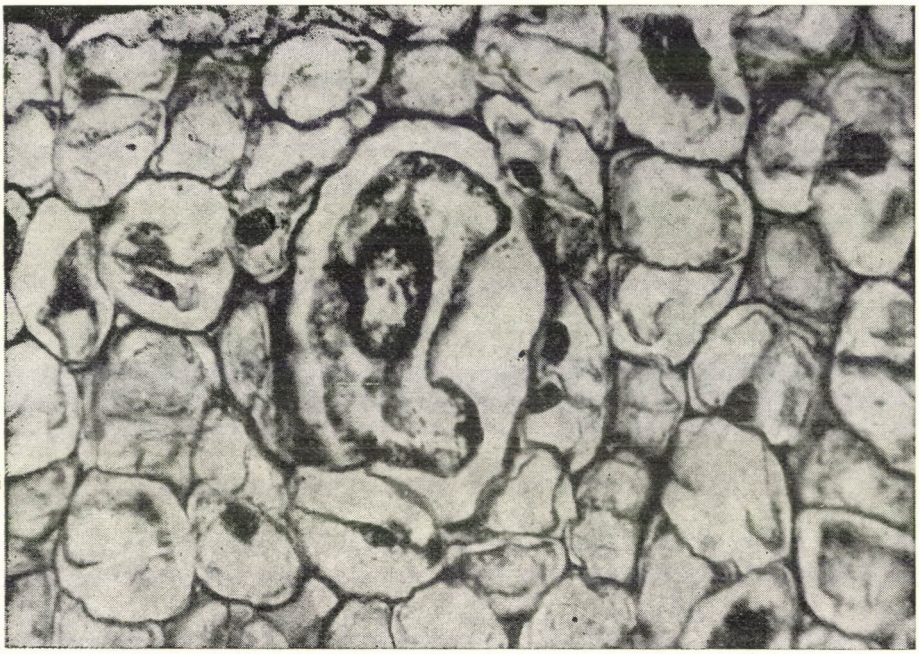

Fig. 3. The process of lysis of the cell-group in the future medulla. Vertical section; × 120

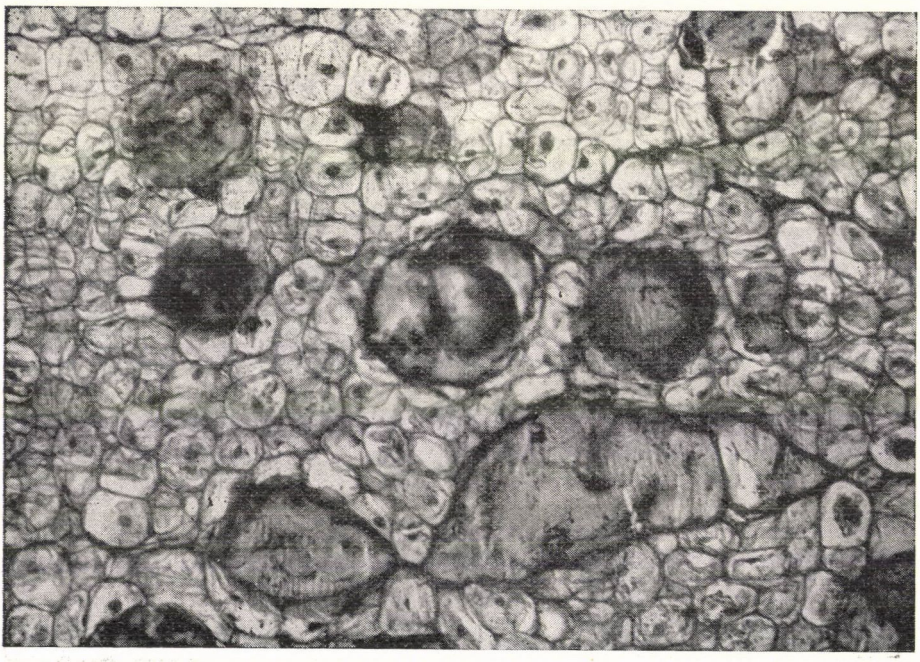

Fig. 4. Excretion holders of different size in the parenchyma getting settled. Vertical section; × 80

NESTLER 1898, JARETZKY—ULBRICH 1934, SPEGG 1957 etc.); however, in these works no uniform and satisfactory answer was given as to differentiation of mucilage cavities in the sense of cell development and histogenesis, respectively. Thus, we have started to study — among others — the differentiating mucilage cavities in the vegetative organs of the rose mallow *Althaea rosea* (L.) Cav. *(Malvaceae)*. On the basis of cross- and vertical sections we have found that during the formation of the basic tissues in vegetative organs smaller or larger intercellulars are being developed through lysigenous way and these intercellulars will, up to the end of differentiation, be filled up with mucilage. The process has its origin in the cells of the basic meristem after mitotic division thus giving rise to pairs of cells some of these cells are being divided by a straight cross-wall. Such pairs of cells might be considered as the initial mucilage holders. The cross-walls of these get dissolved and their plasm will blend (Fig. 1). At that time, however, the nuclei of the cells are, generally, not disorganized yet; in the plasm that contains already mucilage, they continue to divide without the cell-wall being developed (Fig. 2). Finally, due to steadily increasing accumulation of mucilage, and the disorganization of the plasm, respectively, this process comes to an end, and the nuclei get as well absorbed in the course of that metamorphosis. The lysis once started, spreads over the whole group of the neighbouring cells (Fig. 3) resulting in the formation of the elongated or isodiametrical mucilage cavities (Fig. 4). In addition to Althaea rosea, the latter can be seen in the developed vegetative and reproductive organs of most drug plants belonging to the family *Malvaceae*.

*

Prepared by the Department of Applied Botany and Histogenesis of the Loránd Eötvös University, Budapest.

B. DÁNOS, G. JUHÁSZ

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SECOND HUNGARIAN SYMPOSIUM OF PLANT ANATOMY*

Budapest, September 6—7—8, 1966

The 2nd Hungarian Symposium of Plant Anatomy was organized by the Department of Applied Botany and Histogenetics of the L. Eötvös University undert he auspices of the Biology Department of the Hungarian Academy of Sciences

The present symposium, the lectures of which were delivered at the Hungarian Academy of Sciences on the days 6—7—8 of September 1966, was a worthy continuation of the 1st Hungarian Symposium of Plant Anatomy held at Vácrátót in 1958.

Besides Hungarian experts and other people showing interest in the event, quite a number of foreign researchers took part in the work of the symposium. Thus, visitors came from Austria, Czechoslovakia, The German Democratic Republic, The German Federal Republic, from Switzerland and from the Soviet Union.

The 50 lectures (the contribution of 64 authors) being grouped in eight domains of subjects, reported on the recent results of plant anatomy researches.

After his inaugural address, the chairman S. SÁRKÁNY remembered Ferenc HOLLENDONNER. The symposium was devoted to the commemoration of his life-work.

Ferenc Hollendonner passed away 31 years ago in 1935 at the age of 53. — Many important works on comparative plant histology, histogenesis and xylotomy as well as the foundation of anthracotomy are linked with his name. Besides educating work he was performing research work, too. His most prominent work is "The comparative histology of the wood of pines *(Pinaceae)*" which is considered an important source-book even nowadays. His papers on methodology have also been appreciated.

In the last years of his life he achieved considerable results in studying the wood material of prehistoric remains found in Hungary. The successes of his life spent in hard work, encourage furtber research.

J. STIEBER delivered then his evaluating and analysing lecture on Ferenc Hollendonner's chef-d'oeuvre: "The comparative histology of the wood of pines".

Ferenc Hollendonner finished his writing on the comparative xylotomic monograph of pines — unique in those days — in 1913, having worked on it for eight years. The work submits the diagnostic xylotomic description of more than 200 pine species with microscopic drawings made by the author himself.

It is a pity that the monograph hasn't been published in foreign languages up till now though it might command international interest. However, it still forms the basis of works of xylotomic character in this country.

In his next lecture S. SÁRKÁNY spoke about the situation and some results of researches on fine-structure, citology and histology, performed in Hungary.

In the last five years plant anatomy examinations of basic and applied character, have been carried on at 15 research institutions. The themes might be roughly grouped as follows: 1. Plant fine-structure research. 2. Histological-anatomical researches, and within this: *a*) root histogenesis, *b*) tissue differentiation of the vegetative shoot system, — within this frame the examinations dealing with the tissue structure of the wood (methodological-paleophytology relations, quantitative xylotomy, anthracotomy) are to be stressed particularly, *c*) studying the tissue development of the reproductive organs in plants.

The applied plant histological researches involve the examinations of horticultural, — agricultural, industrial — and medicinal plants from different points of view.

The plant anatomy material of the series of publications: "Cultivated Plants of Hungary" being the monographic elaboration of the cultivated plants grown in Hungary, is also a part of the results of the recent five years.

* Hungarian title: II. Magyar Növényanatómiai Symposium

Of the eight domains of subjects the lectures dealing with the differentiation problems of the vegetative shoot and the root tissues were the first to be delivered. H. v. GUTENBERG (Rostock) gave a comprehensive lecture on the "Differentiating processes in the shoot and root of ferns", after which B. KAUSSMANN (Rostock) spoke about the problems on the zone-system of the shoot tip.

L. A. LEBEDENKO (Leningrad) reported on histological and tissue-chemical differentiation of the vegetative and reproductive meristems of the *Coniferae*. M. MARÓTI (Budapest) spoke about the cytological indices of tissue differentiation. This was followed by some lectures dealing with special problems: G. MEINL—J. SCHREITER (Gross-Lüsewitz, Rostock): The Frequent Occurence of Mitosis and Root Growth in *Vicia Pannonica* Crantz; F. KUBJATKO—A. GÖBŐ (Nitra): The Changes of the Root Tip Applying Different Quantities of Nutrients in Winter Wheats; E. S. WOLCSÁNSZKY (Gödöllő): The Effect of Oecological Factors on the Differentiation of Maize Shoots.

Within the frame of *histogenetic secretion*, R. G. SZENTPÉTERY—S. SÁRKÁNY—A. KOVÁCS (Budapest) have established on the young foliage-leaf of *Valeriana collina* Wahlr. that the precursors of the volatile oil appear in the protoderm in the form of refringent droplets; after the appearance of the trichoblast cells the volatile oil gets separated in the plasm, however, not getting marked off, and it is excreted from the plasm surface through the cell wall being covered with the cuticle. A. KOVÁCS—S. SÁRKÁNY have examined the formation of the two kinds of schizogenic volatile oil ducts in the developing pistil of *Heracleum mantegazzianum* Somm. et Lev.

B. DÁNOS—D. G. JUHÁSZ (Budapest) have been engaged in examining the lysigenic formation of the secretion holders in the vegetative and reproductive organs of some species in several plant families. Two main types of the lysigenic intercellulars have been distinguished and it has been established that the lysigenic coalescence of the settled cell groups is a more frequent process than it had been shown by previous knowledge. S. GULYÁS (Szeged) has compared the connection of structure and product in the nectar of the *Lamium* species.

The lectures of the third domain of subjects discuss the problems of *tissue differentiation connected with translocation*. P. GREGUSS (Szeged), dealing with the xylotomy of the *Cycassae* living in our days, has established that in their trunk the transfusion cells are not water storing cells and their morphology is characteristic of the species or genus. In his lecture, R. KOLLMANN, (Bonn) has expounded the functional morphology of the phloem in the *Coniferae*. A. LUX, (Bratislava) has examined the development of the transport-fasciculi in the roots of shoot origin of poplar scions of different quality. I. HORVÁTH—S. GULYÁS—G. LÁSZLÓ (Szeged) have established, on the basis of their experiments performed in phytotron, that the spectral energy dispersion of light exerts a provable effect on the size and the rate of correlation of the tissues in the stem of *Phaseolus vulgaris* and the *Glycine soja*.

Among the lectures of the fourth domain of subjects dealing with the problems of plant cell differentiation, the first one was that of A. FREY-WYSSLING (Zürich) on the differentiation of ultrastructure of plant cell walls. He has stated that according to the orientation of staple fibrils as correlated to the cell axis, there belong to the parallel textures the fiber texture, the spiral texture and ring texture; to the scattered textures there belong the fibrous, tubular and filmy textures. On the basis of the examined cases, the author has come to the conclusion that the ultra textures are the results of genetic development. D. FENGEL (München) has spoken about the variations in the foveolae formation of trees deciduous and coniferous; the lecture has been illustrated with electron microscopic pictures. L. FRIDVALSZKY (Budapest) has reported on the differentiation of the ultrastructure of the cell wall in *Characeae*; Z. FILLÓ (Budapest) submitted data to the submicroscopic structure of the xylem fiber of some domestic tree species; K. MÜHLENTHALER (Zürich) elucidated the correlation between the ultrastructure and function of the tylacoid membranes of plastices. Mrs. T. NAGY (Budapest) examined the light-

and electron microscopic structure of chloroplastices in *Botrydium granulatum* Grev; B. LOVAS (Budapest) compared, in an *Euglena species*, the fine structure peculiarities with function; W. URL (Wien) discussed the light microscopic structure of the endoplasmic reticulum; F. Á. DÁNIEL—H. A. NAGY—I. GYURJÁN (Budapest) examined the correlation between the morphologic irregularities and photosynthetic activity of chloroplastices in carotinoid-mutant maize strains.

The lectures in the fifth subject have discussed the differentiation phenomena occurring in the reproductive phase. A. ANDRÁSFALVY (Budapest) has examined the cyto-histological bearings of the real and functional male sterility in tomato and onion. M. LUXOVA (Bratislava) has spoken about her experiments on the pollination of barley and its energy sources. The lecture of O. ERDELSKA (Bratislava) has revealed the fact that on the basis of the structure and size of the antipode cytoblast, the developmental phase of the embryo sack can be established. S. SÁRKÁNY—P. GRACZA—H. PAÁL (Budapest) have observed the formation and initial development of the endospermium in *Papaver somniferum* L. and established that the formation of the first elements of the primordial endosperm get located around the antipodial pole and this phenomenon might be integrated with the high-rate endopolyploidity, its role of energy- and nutrient intermediator. P. GRACZA (Budapest) has observed the development of the pistil in certain species of *Oleaceae*.

Within the frame of the sixth domain of subjects, the authors have reported on comparative and experimental examinations regarding the tissue differentiation of tree trunks.

The lecture of J. B. HUBER (München) has expounded the limits in distinguishing genus and species in tree anatomy. J. STIEBER (Budapest) dealing with the problem of xylotomic diagnostics in the European *Larix* and *Picea* species, has found that concerning the xylotomic peculiarities that can be made use of as a basis of identification, the scientific literature contains many contradictory data. Relying upon detailed quantitative oecological, xylotomic measurings, author has proved the variability and its lawfulness of several properties considered suitable for diagnosis. L. GENCSI (Sopron) has delivered a lecture under the title: "The role of some factors in the formation of the annual ring structure in forest trees." W. NECESANY (Bratislava) was dealing with the effect of illumination on the development of the secondary xylem and the cell walls. G. CASPERSON (Berlin—Teltow) has examined the effect of growth substances on the differentiation of wood elements. R. ZENKER (Eberswalde) has reported on the distribution and occurrence of tension-wood in different poplar species. R. HÖSTER—W. LIESE (Hamburg—Reinbek) have performed reaction tissue cytological examinations in 260 plant species and have submitted their results. H. SÜSS (Potsdam) has observed the change of length in the wood fibers in the course of a growing period. G. SCHULTZE-DEWITZ (Eberswalde) has spoken about the appearance of the real — and false annual rings in the *Pinus palustris*. Z. FILLÓ—K. BABOS (Budapest) have been dealing with the correlation between the libriform quotient and the tending-strength values. E. MÄDEL (Potsdam) has found, in the course of his investigations, what anatomic types are represented by the fossil oaks belonging to the *Quercoxylon* artificial genus.

In the domain of *foliage-leaf anatomy* four lectures have been delivered. M. JUHÁSZ (Szeged) has examined in 15 *Solanum* species what effect the oecological factors exert on leaf epidermis (Stoma number, stoma index, and the size of the end cell). V. G. PETRI (Budapest) has studied the quantitative function of stoma division on the foliage leaf of *Datura stramonium* L. and *Vinca minor* L. — I. MARÓTI. (Szeged) has, with the aid of comparative leaf anatomy examination of *Schizaeales*, grouped the species of the four genera into three families—in contradiction to literary data available hitherto —, and has elucidated phylogenetic connections. J. VARGA (Szederkény) has paid attention to a problem being interesting from a practical point of view: the pathological tissue deformations on the leaf, shoot and fruit of peach.

The lectures of the last (eighth) domain of subjects were dealing with the *differentiation*

phenomena occurring in tissue cultures. Mrs. L. GÖRGÉNYI—M. MARÓTI (Budapest) have examined the organization of cells, tissues and organs in the callus tissue obtained from the *Daucus carota* root. They have established that the differentiation phenomena can be observed in the callus tissue being bred further on nutrient substratum only. On the experimental material the development of the root has been paid attention to.

L. KLUJBER (Pécs) has described — in nutrient substratum — the effect of the IES-kinetin gibberellin system on growth and differentiation in the tissue culture, that can be further inoculated, of *Convolvulus arvensis.* His results prove that the IES-kinetin system plays an important role in directing organ formation. E. KOVÁCS (Budapest) has studied the differentiation of organs in the tissue cultures originating from the tumors of *Nicotiana* hybrids.

Finally I. MÁTHÉ (Budapest) made his exposé on the situation of the histological work concerning the series of publications under the title "Cultivated Plants of Hungary" as well as on future tasks.

The participants of the symposium will surely remember the social evening that was a real success, and it is hoped that they will keep in memory the sightseeing ride in Budapest.

É. CSAPÓ

THE DEVELOPMENT OF THE PISTIL IN SYRINGA VULGARIS

Since the publication of VAN TIEGHEM's work (1871), those appearing later (KNOBLAUCH 1892, VELENOVSKY 1910, MAC KELWEY 1928, WEBER 1928) have but alluded to the formation of the pistils in the species belonging to the *Oleaceae.* As it is well known, the pistil in the species of the family, and thus the pistil of the lilac *(Syringa vulgaris* L.), too, is high-positioned.

In general, the above-mentioned authors have examined the pistils at a developed stage. In the frame of the present short paper the author would like to report on the developmental phases of the pistil of the lilac.

In the developing mixed bud the differentiating flower-primordia of the primordial inflorescence show, at the beginning, in their vertical section the form of a rhombus. Then there starts on the brim of the flower-primordium intensive cell division as a consequence of which the shape of the flower-primordia will get flattened. Later the cell division can be observed most intensively on the edge of the flower-primordia and soon the four calyx-primordia appear with subprotodermal initiating. This is followed, in alternated position, by the development of four entirely separate petal-primordia. After the two transversal stamen-primordia in the median plane, the two carpel-primordia — growing upwards —, develop the prospective ovary hollow. At that stage the sidewalls of the primordial ovary are exclusively formed by the tissue of the primordial carpels. In the course of further development of the young petals, the primordial corolla and stamina get interlaced on the basal part with congenital character and that process affects also the pistil primordium so that the hollow of the ovary can be observed sunken in seemingly low position (Fig. 1). At this phase the formation of the pistil-primordium is similar to that of the young pistils in the species belonging to the *Umbelliferae* (SÁRKÁNY 1962).

Further on, after the hollow of the ovary has become closed, the freely developed parts of the primordial carpels, growing upwards, produce the cylindrical style. The cells of the other floral leaves *(calyx, petal)*, gradually finish as well their division and attain their final size. Meanwhile, above the level of fitting of corolla tube, in the tissues at the sidewall of the developing ovary the intensity of cell division increases (Fig. 2), as a consequence of which the originally flat, cake-formed ovary gets considerably elongated, becomes pear-shaped and protrudes as compared to the level of origin of the other floral leaves. The protruding of the ovary increases

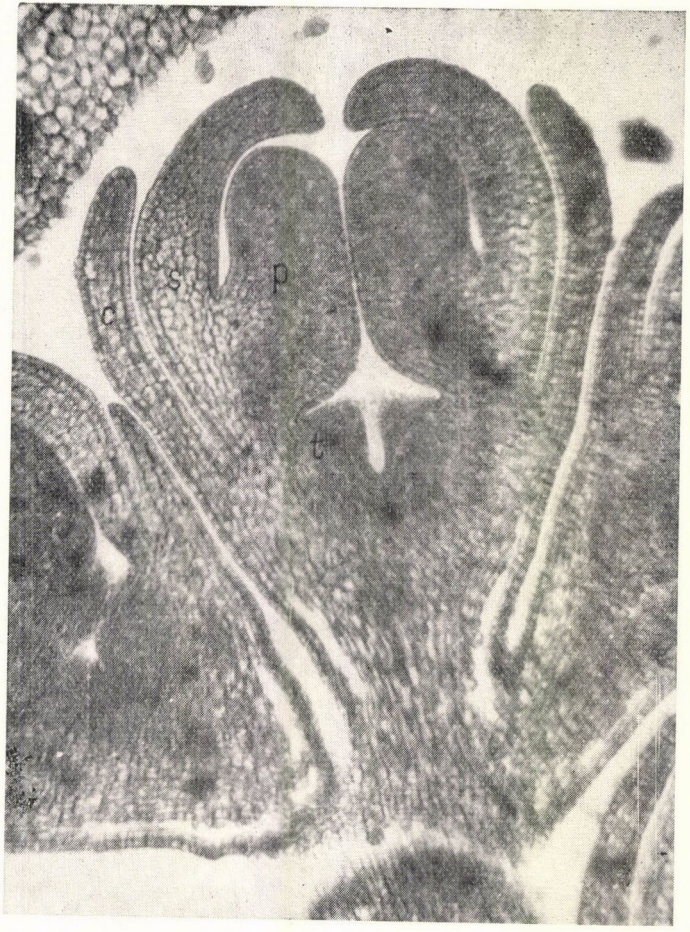

Fig. 1. Flower-primordium of *Syringa vulgaris* with seemingly low-positioned pistil-primordium. The ovary-primordium *t* is sunken, the calyx *c*-, petal *s*- and the stamen *p*-primordia set out from above the ovary-primordium. (obj. 20×, oc. 5×)

Fig. 2. In the sidewall t_1 of the ovary-primordium that had been cake-formed at the beginning, vigorous cell-division gets started (obj. 10×, oc. 5×)

Fig. 3. Through cell divisions t_2 occurring during the previous division and formation of ovary-primordium, the pistil gradually protrudes (obj. 10 ×, oc. 5 ×)

Fig. 4. By the time of flowering, the pistil becomes high-positioned, the calyx *c*- petal *s*-leaves below the level of the pistil *t*. (obj. O ×, oc. × 5×)

through the cell divisions quickening up at the basal part of the ovary (Fig. 3). By the time of flowering the pistil has got into typical upper position: the other floral leaves (the stamen-, petal- and calyx-leaves) will start from the level below the ovary (Fig. 4).

On the basis of peculiarities shown in the course of formation, the pistil of lilac can be considered a transitional type between the seemingly low-positioned pistil of the *Umbelliferae* and the formation of the typically high-positioned pistils.

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TÁPLÁNSZENTKERESZTI VÖRÖSHERE

(Táplánszentkereszt Red Clover)

Taxonomic category: Trifolium pratense L. convar. *subnudum* (WITTE) MY provar. *praecox* (WITTE) MY.

Origin: Coming from crosses of the regional varieties of Táplánfa, Körmend and Kőszeg (JÁNOSSY 1963).

Beginning of breeding: 1949, Táplánszentkereszt.

Breeder: MIKLÓS DEUTSCH, Táplánszentkereszt.

State qualification: 1954, state certified improved variety (KAPÁS *et al.* 1965).

General features: Growing can be considered safe; it is frost resistant with dense foliage and is a high-yielding intensive variety that can be cut twice.

Morphological description:

Root system: The tap-root penetrates down as deep as 60—70 cm, with dense ramification at a shallow depth.

Root stock: Stubby, sprouting well and inclined to get thick.

Shoot system: It consists of upright tillers growing as high as 40—70 cm. Stalks are delicate and in dense stand they are thin, however, stable.

Foliage: Dense; the leaflets are stubby or of elongated egg shape, in some cases egg-lanceolar. On shoots the proportion of leaves is about 50 per cent.

Inflorescence: On one plant there develop about 15—61 mostly pointless coniform capitula. In these the number of flowers is from 27 to 128. The corolla of the flowers is 8—10 mm long, the colour being of uniformly light carmine (BÁNYAI 1966).

Fruit: Generally stubby, egg-shaped pods with one grain in it.

Grains: The colour is yellow, brownish yellow, sometimes purplish; the weight of thousand grains is 1.5—1.9 (2.0) g.

Biological features:

Germination: Begins as early as just above freezing point; the optimum being 25 °C (minimum 1 °C and maximum 43 °C).

Vegetation period: In the first year, 130—150 days reckoned from sowing to the ripening of the seed; the length of the significant phenophases: from sowing to flowering 85—98 days, from flowering till maturation of the seed 45—50 days and after first cutting, respectively, 95—105 days (JÁNOSSY 1963). Reasonable lifetime 2 or, not more than, 3 years. In the second year it is sure to get 2 and perhaps 3 cuttings.

Development: Slow at the beginning which, however, becomes quick later on. Due to excellent shooting capacity, dense stands can be obtained.

Winter-resistance: Excellent.

Disease-resistance: The variety is fairly resistant to powdery mildew and mosaic virus, while it is definitely resistant to blight infection.

Inner consistency: It contains 15—21 per cent dry material and 16—24% protein.

Agrotechnical requirements:

On good soils it gives high yield, however, under dry conditions it should not be grown. Favourable time of sowing in Hungary is March (early spring), and if the weather is suitable, even February. It is sown with spring barley as cover crop, reckoning with 7—8 million plant per cadastral yoke.*

Cutting should be performed at the time of budding or not later than at beginning of flowering. (It gives as early as in the first year satisfactory cutting yields). The yield in seeds depends on the activity of insects that accomplish pollination since it does not get pollinated from the own pollen (self sterile).

Productivity: Excellent; the product in hay on the occasion of the first cutting is 30—37 q/cadastral yoke,* total yield of hay 51—76 q/cad. yoke; green yield 235—331 q/ha; average grain yield depending on the region and the year, is between 1.27—2.67 q/ha (KELEMEN 1962, KISS 1966).

Growth-region: The western counties of Transdanubia.

GY. MÁNDY

* 1 cad yoke = 0.575 ha

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CHRONICA

NÁNDOR GIMESI

1892—1953

Nándor Gimesi was born in Kiskomárom on the 3rd December 1892. He made his grammar school studies in the Székesfehérvár gymnasium of the Cistercian Order in the years 1904—1912. He then continued his university studies at the theological and philosophical faculties of the Pázmány University and in 1918 he took his grammar school teacher's degree in natural history, geography and chemistry, and in 1920 his doctor's degree. As ordained priest and member of the Order he taught in the Gymnasia of the Cistercian Order at Zirc, Székesfehérvár and Budapest. In 1925 by obtaining a Rockefeller fellowship he can pursue hydrobiological and biocolloidical studies in Switzerland (Luzern, Zürich), Germany (Pöln, Helgoland), Norway (Bergen) and Sweden (Lund).

A year later his thesis was submitted under the title: "The technical and biological application of colloids" at the Technical University and from the next year on, he lectured at the colloid chemistry, as a qualified lecturer. From 1937 as an associate professor at the same university he was lecturing even at a special biocolloid chemistry. A few years later (in 1943) he became the full professor of the Institute of Plant Physiology and director in the Botanic Garden of Pázmány University. The re-organized Hungarian Academy of Sciences also elected him among its corresponding members. In 1952 appointed to the director at the Scientific Institute of the Botanic Garden of Eötvös University he held his office until his death ensuing after a short illness (July 16, 1953).

As a researcher he had studied, at the beginning of his scientific career, the structure of the living plasm and the regularity of its division, primarily

from biocolloidic viewpoint. He investigated the different phases of karyokineses with the aid of polarization microscope and ultramicroscope in order to get to know the submicroscopic constructions. While studying, as holder of a scholarship, the colloidal structure of *Cyclotella lemanensis* in Switzerland, he proved that in the integument the thread elements of protein were of orientated ultrastructure, having been their birefringency verified in polarized light, with the aid of ultracondensor. It was here, in the twenties that he examined the structure of developing plant cell wall and the primary cellulose fibres with X-ray diffraction, method that was considered one of the most modern trends in those years. By the aid of the ultrafilter constructed by himself, he had many a success — at exhibitions — in separating colloid systems. This colloid filter has as well offered a possibility to determine the pore sizes. The problems of identifying the filters have also been discussed at theoretical level, enumerating the possibilities of practical application. In the field of biocolloid systems he was particularly dealing with the phenomenon of thixotropy mostly in connection with the change of sol-gel state of the protoplasmic streaming. At the beginning of the forties he made an important cytogenetic statement regarding the fragmoplast structure and ultrastructure developing at the end of division in the course of plant microsporogenesis. Fragmoplast plays an important part in the formation of cell wall, while dissolving in the meiosis, at the beginning of the second division which is then followed by tetrad formation. He has proved directly through microcinematography that in the formation of fragmoplast developing after the first division and dissolving secondarily during the second division, the protoplasmic streaming plays a very important role. He has studied the importance of fragmoplast in the development of cell wall formation with the aid of polarization microscope. Research work took a direction towards the physiology of the development and differentiation in his institute, and by organizing a research group with modern views he made it possible to have experimental questions raised on the up-to-date problems of plant physiology. In possession of the experimental biological aspect, he found it extremely important to study the basic problems of theory.

He had remained to be the highly cultured natural scientist and a true man during the raging cruelties of the right-wing terror. He gave meaning to the ideas of humanism and christianism, and when remembering his noble and sublime way of life, it is with right to say in memoriam: he lived among us and always acted in the proper way.

B. I. POZSÁR

Acta Agronomica Academiae Scientiarum Hungaricae Tomus 16 (3—4), pp. 447—453 (1967)

RECENSIONES

J. DI GLÉRIA: *Izotópok alkalmazása a mezőgazdasági kémiában és a talajtanban* (The Use of Isotopes in Agrochemistry and Soil Science). Akadémiai Kiadó, Budapest 1966, 318.

This work edited by János di Gléria with the contributions of eight co-authors supplies a great need in agricultural scientific literature.

The use of isotopes in the pure and applied biological sciences is not more than twenty years old, while here in Hungary a decade has passed since the first agricultural isotope laboratory began its operations.

HEVESY, the Nobel prize-winning scientist of Hungarian origin who recently died evolved together with PANETH a method published in 1913 which has been made only by the large-scale production of isotopes, the accumulation of information about radiation biology and the large-scale development of measuring techniques an effective tool of research. The "tracer" method, essentially an analytical one, has become in many respects a new branch of science and contributed, to a great extent, to the development of various applied natural sciences.

Nowadays almost all branches of agricultural research are to use the method of radioactive indication it is — however — not accidental that these methods have proved the most fruitful for solwing problems of agrochemical research.

In recent years many works have been published on the use of radioisotopes in agriculture. In English literature the most important work is COMAR's Radioisotopes in Biology and Agriculture published in 1955 and in 1960 was published a german book entitled Isotope in der Landwirtschaft and written by H. LINSER and K. KAINDL. Besides there are volumes including agricultural lectures held at the conferences of the United Nations Organization as well as the publications of other international and national conferences summing up the results of the field.

As denoted by the title János di Gléria and his collaborators endeavour to survey a narrower field of agricultural research, the use of isotopes in agrochemistry and soil science.

The book answers three major questions. It informs those in other fields of agricultural research on the results achieved so far by the use and further possibilities of the isotope method. It is also a methodological handbook for soil science and agrochemical experts as it treats in detail the applied special methods of measuring with isotopes in agrochemistry and soil science. Finally the authors while giving detailed reports on the results of their own research they summarize most of the achievements of isotope research in Hungarian agriculture.

The 12 chapters of the volume are supplemented by abundant references comprising a rather ample bibliography of the subject thus making the sources easily accessible on the present state of the use of isotopes. The Foreword to the book has been written by Dr. G. Soós, deputy minister and head of the agricultural subcommittee of the National Atomic Energy Commission. Chapters 1 and 2 give general information on isotopes and

describe the basic measuring techniques. Chapter 3 may be considered only in a wider sense as falling within the scope of agrochemistry since it summarizes the results of the use of isotopes in photosynthetic research. Chapter 4 concerns the isotope research in the field of mineral nutrition. Chapter 5 discusses the problems presented by radiation biology when using isotopes in plant physiology.

Chapter 6 treats classical agrochemical isotope research. The title of this chapter is: "The Isotopic Examination of the Utilization of Fertilizers." This chapter is especially valuable by treating in great detail the author's own experiences with the production of radioactive fertilizers in the laboratory. Chapter 7 is a helpful guide particularly for irrigation experts as it concerns the use of tracer elements in measuring water movement and water quantity. Chapter 9 similarly treats the problem of subsoil water. Chapter 8 ("Application of Isotopes to the Study of Sodic Soils") shows in a few short subheadings the new results that have been reached by Hungarian soil science with the help of isotopes in this field of research having such a great past.

Chapters 10 and 11 report on the results of soil chemical and soil biological research including in detail the methodical aspects of the use of isotopes.

Finally Chapter 12 summarizes the principles of radiation protection in agricultural experimentation with isotopes.

L. GÁSPÁR

G. C. DOBY: *Plant Biochemistry*. Publishing House of the Hungarian Academy of Science and John Wiley et Sons Ltd, Budapest—London. 1965, 768.

The manual is divided into three parts. Part I discusses *assimilation* i.e. the processes of biosynthesis. The introductory chapters deal with the types of biocatalysis and with the inorganic and organic biocatalysts. In *biocatalyses* the inorganic ions behave like special activators. The author stresses the biochemical importance of the trace elements in connection with regulating the intensity and the direction of biosyntheses. The chemical, biochemical and physiological role of *vitamins* in the processes of biosyntheses of green plants is written about with full particulars.

In the book the plant hormones are categorized according to cell- and tissue differentiation. Besides auxine (indo-3-acetic acid) the author reports on the special effect of several other synthetic auxines (2,4-dichlorophenoxyacetic acid, naphtoxyacetic acid, phenoxyacetid acid, etc.) and derivatives of hormone effect as well as on the relation of protein and nucleic acid with metabolism in the course of growth. The gibberellins, too, are described as growth- and development-regulating hormones, and the interaction of the gibberellins and the special endogene growth inhibitors is also discussed by the author. The cell division regulating biological activity of the quinines (cytoquinines, phytoquinines) is described in the interaction of the two other hormone groups.

The chapter dealing with the assimilation of carbon shows the physico-chemical, bioenergetic and biochemical information on photosynthesis in the modern aspect of recent years. The chemical structure of the primary light-absorbent of photosynthesis, the chlorophyll, the mechanism of its biosynthesis, the micromorphology and photochemical activity of its localization in the chloroplast are expounded. After describing the method of quantitative measurings, the Hill-reaction is discussed in the relationship of different stimulating and inhibiting factors. Author describes, in detail, both types of the biosynthesis of macroerg phosphoryl bonds developing through the energy transport of photosynthetic phosphorylation; these are the cyclic photosynthetic phosphorylation, the cyclic photophosphorylation and the continuous photosynthetic phosphorylation shown chiefly on the basis of Arnon's experimental data. The Calvin-cycle is shown by the author in the mechanism of carbon dioxide fixation. The carbon dioxide fixed by ribulose-1,5-diphosphate leads to the syn-

thesis of two molecules of glycerin acid-3-phosphate, and the development of the primary product could be evinced directly by way of fixing the carbon dioxide labelled with radioactive carbon. This chapter also gives a detailed account on the bioenergetic characterization of carbon dioxide fixing. The carbon dioxide fixation connected to the process of chemosynthesis is described mainly through the biochemical mechanism of sulphur bacteria.

By expounding the bioenergetic importance of the biosynthesis of phosphate bonds, the chapter discusses the phosphate metabolism to which the carbohydrate metabolism is closely connected. The carbohydrate metabolism comprises the interconversion of monosaccharides, the biosynthesis of polysaccharides and the development of other special carbohydrates of the cell wall. The biosynthesis of fats and oils and the biologic importance of phospholipids are also discussed in connection of enzymologic data.

The book shows in special details the nitrogen metabolism introduced by the schema of the biosynthesis of amino acids, peptides. The biochemical mechanism of protein synthesis is made known by using the modern data of molecular biology. The messenger ribonucleic acid chains forming on the deoxyribonucleic acid templates pass on the genetical information for the peptide synthesis occurring on the surface of ribosomes. The basis-sequence of the messenger ribonucleic acids determines the sequence of the activated amino acids in the polypeptide chain. After having introduced the modern theories of nitrogen fixing and nitrate reduction, the chapter on nitrogen metabolism closes with the classification of plant proteins and then, with the description of the different protein metabolisms in various plant organs.

The last chapter of part I discusses the chemical structure of special nitrogen containing compounds in the plant organisms and the enzymic reactions occurring in their biosynthesis processes, as well as the biochemical importance of secondary materials (organic acids, terpenes, carotinoids, flavones, antocyanides, etc.).

Part II contains the dissimilation mainly from the viewpoint of enzymology. Author shows the importance of the redox processes as related to bioenergetic changes. The mechanism of the biocatalysis of dehydrogenases, hydrolases and the special oxidases are made irreversible as a result of the energy transport changes by the bioenergetic character of the redox potential changes. The important processes of dissimilation mechanism are the anaerob glycolysis (alcoholic fermentation, intramolecular cell-respiration, lactic acid fermentation, acetic acid fermentation, etc.) and the oxidative cell-respiration systems; its regulation by external factors the oxidative decomposition of the metabolites are described in this chapter with special accuracy.

Part III reports on the correlation of biological processes in biochemical transformations. The metabolites and antimetabolites have special pathological-biological importance which is discussed in the closing part chapter of part III.

The chapters are complemented by ample literary references, and the book comprising the whole field of plant biochemistry, is concluded by the indexes of authors and of subject.

A modern summarizing of the far-reaching material and the enzymologic expounding of the essential schemata of basic problems of plant biochemistry are submitted in the vast volume written by the disciple of Emil Fischer.

B. I. POZSÁR

W. SCHUSTER: *Inzucht und Heterosis bei der Sonnenblume (Helianthus annuus* L.). Habilitationsschrift. W. Schmitz Verl. Giessen. 1964. 1—135.

In the breeding work concerning the mandatorily cross pollinating sunflower the examination of all biological issues connected with its flowering and fertilization is an important scope of problems. The author's investigations and the data of the pertinent literature substantially amplify our knowledge

and a comprehensive discussion of what is found in this work fills a long felt gap. Schuster in his book circumspectly deals with all important questions related to inbreeding and heterosis. The material of knowledge is reviewed in five chapters and the contents closed with detailed summary and ample references.

In the first chapter we become acquainted with the results disclosed up to now of inbreeding and heterosis and with their relationships in plant breeding. The more important theories on the phenomenon and data gained for the various cultivated plants are recorded. It is a great merit of the chapter that it affords not only a good orientation as to the conceptions connected with inbreeding and the heterosis phenomenon but also a critical evaluation. When discussing the various problems the author — to the results obtained for other species — joins the findings gained for the sunflower. The chapter also discusses the breeding methods elaborated on the basis of the various theories.

The second chapter deals with the biology of flowering and conditions of fertilization in sunflower, reviewing the flowering conditions of sunflower, its characteristics, the march and daily rhythm of flowering and their connection with fertilization. The author with the investigations of several years has established that fertilization takes place much more rapidly with cross pollination than with self-pollination. There are, however, deviations from this general finding, particularly in some years and in some plants of the population where at simultaneous cross and self-pollination higher fertilization per cents have been found than expected.

Chapter three discusses the effects of inbreeding, examining the effect separately in the relationship of self-fertilization, amount of yield, plant height, diameter of inflorescence, sterile central part of inflorescence, seed to shell ratio and oil content. The data reveal that self-fertilization slightly diminishes up to I_5 and then, as a result of the selection of the self-pollinating types, it increases again. The action of inbreeding on the yield is much more important, reaching its minimum in I_4 when the reduction as compared with the starting material is 67 and in some cases even 47%. The height diminishes to a lesser extent as compared with the yield and reaches the minimum in the I_7. At the beginning, the reduction is more considerable, 6 per cent in I_1 and 13 per cent in I_2. As to the other characters, a very slight depression was observed. At isolated growing in small plots the populations exhibited only after 8 years the inbred depression similar to repeated selfing.

Chapter three makes us acquainted with the correlation calculations conducted between the various characters in different inbred generations. A definite correlation was found between crop yield, plant height and inflorescence diameter. The inbred depression of these characters remained in close correlation with each other until a certain degree of the onset of flowering. The sterile central part of the inflorescence was in correlation with the size of the latter. Proportionally with the prolongation of the vegetation period plant height and inflorescence diameter increased but the crop yield diminished, that is the earlier generations were more fertile. Positive correlation was observed between the oil content of seeds on one hand and crop yield and plant height on the other, while a negative correlation was found between shell per cent and oil content.

Chapter four discusses the heterosis phenomenon in sunflower. The results of crosses with inbred progenies were manifold and only in part of them was hypertrophy, higher values as compared to the starting forms established. The value of F_1 as related to the parents ranged from 81 to 170 per cent in the amount of crop yield. In plant height the best crosses attained 147 per cent but also values lower than the ones in parents also occurred. The maximum surplus in inflorescence diameter was 160 per cent. For the sterile central part of the inflorescence also better fertilization was obtained. Very slight was the fluctuation in the value of the shell to seed ratio (98—102 per cent) and of the oil content (98—113 per cent).

On the basis of the regressions of maternal and paternal inbred progenies and their F_1

crosses also the heritability of the various characters was studied. It has been established that the highest h^2 values were exhibited by the plant height both in the relation of the maternal and paternal march of succession. Since the oil content of seeds, the crop yield and the fuller loading of the inflorescence showed higher heritability values rather or exclusively in the maternal progenies, the author safely concluded on the plasmatically inheritable relations of these characters.

On the basis of the study of inbreeding effects and heterosis phenomena different hereditary mechanisms were recognized in the various properties. This is why in the various characters heterosis effects of different extent arise, as they are governed by different hereditary processes. While further studying the possibility of better utilization of the heterosis effect it has been established that explicit results can be safely obtained by the cross of the inbred progenies and the maternal variety (top cross) whereas with combination breeding the heterosis effects manifesting themselves in connection with the various features can also be maintained in the progeny and this way even the advantages in feeding of the various characters (more extensive foliage, vigorous vegetative body, soft hairs, etc.) can be substantially increased.

In Chapter five results obtained from special literature and from the own investigations of the author are evaluated from the viewpoint of practical breeding. Among the pertaining methods the top cross and combination breeding seem to be most promising. Beside these the recurrent and reciprocal repeated selection promises substantial aid in the maintenance of varieties and in the production of new varieties. Providing we want to avail ourselves of the classic hybrid breeding methods such as the single and double cross, first male sterility must be either genetically or chemically released.

The work relying on a rich material of literature and experiment affords much aid both for scientific research and practical breeding as well as gives satisfactory information also to those wishing to deepen their knowledge concerning the most important issues of sunflower breeding.

GY. MÁNDY

I. CSAPODY, V. CSAPODY, F. ROTT: *Erdei fák és cserjék* (Forest Trees and Shrubs). Mezőgazdasági Könyv- és Folyóiratkiadó Vállalat (Agricultural Book- and Periodicals Publishing Enterprise). Az Országos Erdészeti Főigazgatóság kiadványa (Publication of the National Board of Woods and Forests). 328, + 123 Figs and 114 coloured Tables.

A very valuable work issued by the National Board of Woods and Forests has appeared through the Agricultural Book- and Periodicals Publishing Enterprise. It submits information on our forest trees and shrubs; the bulk of its text, like: introduction, the fundamental conceptions, the morphologic description of the tree- and shrub species discussed, the floristic, oecological and coenoecological characterization as well as the construction of 123 maps of area have been treated by ISTVÁN CSAPODY, together with the phenologic tables, FERENC ROTT has described the tree species pertaining to the sylviculture, while the water-colours of the coloured tables have been made by VERA CSAPODY in the artistic elaboration in her accustomed excellent manner and also with great professional knowledge.

The work was aiming at the composition of such dendrology of forestry which, as a supplementary part of a series appearing in 1963—64 under the title: "Directives and Processes on Forest Renewal and — Laying out in the Forest Regions of Hungary" and containing 9 volumes and 1 map, should become a high-levelled scientific manual for experts of sylviculture based on forest-types, however, with the view to serve also those who are fond of woods and trees.

Abroad, there exist numerous more or less important works on forest trees and shrubs which, however, are rather meant to meet the requirements of those showing interest in sylviculture without special knowledge about it.

The moment we take this work in our hands, it becomes evident that it is something quite extraordinary: this is a manual for forester experts and not only well-known facts being compiled in a more or less right way — like the majority of such works; the book in question is a high-level synthesizing work of authors who know the subject thoroughly. It presents information in such a way that the reader gets to the level of the most modern scientific knowledge being discussed briefly and easily understandable. Authors not only submit a clever and well arranged compilation — they include also their own observations when submitting data on the description of plants, on plant geography and especially on coenology, giving also something new for science. Thus, it is an important source for botany pertaining to the forestry. Each of the coloured tables is an original work of art. Of these especially the figures of the seedlings are in every respect — even in international relation, — quite new in the similar literature.

The "Introduction" comprises the object of the work, the points of view considered in the composition and in writing the book; the division of the work between the 3 authors, and an enumeration of the experts that have taken part in the book coming to existence.

The chapter called "Fundamental conceptions" includes the concept of the history of evolution enumerating the most important works referring to it; the determination of taxonomical concepts, the valuation, definition and application of taxons; the rules of nomenclature, the proper way of writing the names; this is followed by information on morphologic concepts. In the frame of the chapter: "Concepts on plant geography" author explains the ideas on floristic plant geography; in the part: "Concepts on oecological plant geography" we find the definition and detailed enumeration of oeco-groups, their index number and the indication of their denominative species; the part: "Coenological plant geography" describes the conception on plant associations as well as the more frequent woody plant associations enumerated by their Hungarian and Latin names. The separation of *Quercetum robori-cerris* as independent association, is a new issue from scientific point of view.

This is followed by the part called "Concepts of habitat-sylviculture" mainly containing an enumeration of soil types and the abbreviation of same.

Bulk of the work is the part titled: "The description of forest trees and shrubs", in which the material is discussed in the sequence of evolutionary plant taxonomy by family, genus, species; there we find, in every case, a morphological description referring to each organ separately as well as plant geographical relations, the area and finally, very detailed coenologic data containing also many original observations pertaining to the forest. The main feature of the work first appearing in literature of this country, is that to each species there is also attached the map of the area partly taken over and applied in the form of maps — always mentioning the source, too — partly being designed by the author himself on the basis of literary data, and sometimes supplemented by his own observations.

The discussion of the material in taxonomic sequence also displays the high scientific level; the definite aim of the author was to evoke in the reader the way of looking at things at the level of evolutionary system and coenology. In general, it can be established that works being of such a high level, discuss their material in taxonomic sequence, while the materials being enumerated in alphabetic sequence or according to some other viewpoints are of lower level to be read by merely men of practice, and are written in a popular manner.

The 114 coloured tables are all made after the original water-colours of V. CSAPODY; the material comes from her own collecting and thus, V. CSAPODY is not only the artistic illustrator but even more, the author of the tables. Tables 1—15 represent the seedlings, Tables 16—34 illustrate the shoots and buds, those numbered 35—64. show the leaves, the Tables 65—91 the flowers and finally, the Tables 92—114 submit the cones, fruits and seeds.

In the Appendix the phenologic data of firs are shown in 2 tables, the deciduous trees and shrubs in 8 tables in the alphabetic sequence of species, according to months. Unfortunately, the key of colours, the explanation of the green indicating the time of leafing; the yellow showing flowering and the red referring to the ripening of the fruit and seed, respectively, — are missing. At first glance this renders difficult to understand the tables; it would have been worth while to remedy the omission in some way.

Then follows the enumeration of literary references; separately are treated the dendrologies, the monographs together with shorter dendrologic communications, books of determination and manuals, the publications on plant geography and finally, miscellaneous works. This enumeration comprising the titles of 141 works, shows in itself the authors' accuracy and their comprehensive knowledge in the special literature on the subject.

This is followed by the so-called "List of Figures" indicating in alphabetic sequence both of the Latin and Hungarian names, the respective table in which a certain part of the species in question can be found. Big figures indicate the table, the small ones the figure. Since the authors have included these figures in the text, too, this arrangement renders very easy to find the respective part of the text and the tables. Finally, the text ends with the Latin and Hungarian index.

The work has been published bound in two colours. For the general public it is available with a cover in light beige, however, for the use of forestry it is green which also proves this work to be in close connection with the above-mentioned series consisting of 9 volumes.

Recently, Hungarian sylviculture underwent considerable changes; the previous sylviculture carried out according to determined cadastral forest fields and based on much more practicism than today — has turned to a scientific way of cultivation depending on natural circumstances and based on forest typology and area. This is very well proved by the above-mentioned series. Typology simplifies the theoretical science of the forest plant coenoses for the requirements and views of sylviculture thus being utilizable and applicable for practice, too. It is in this interest that the work "Forest trees and shrubs" tries to submit the necessary theoretical bases at a high scientific level applying the most up-to-date terminology and nomenclature in the study of organism, in taxonomy as well as in plant geography. Of the authors F. ROTT has elaborated the problems pertaining to the sylviculture, I. CSAPODY being a forestry engineer has compiled his material from the viewpoint of the forester being, however, at the same time a researcher in the field of forest botany and especially of coenology, he has included many a new and original ideas in this compilation being new in many other respects, too. V. CSAPODY who is engaged scientifically in the morphology of seedlings — a book of determination is under preparation — and also deals with illustrating domestic exotics, has made this work even more valuable by her water-colours produced on the basis of materials collected by herself.

The generosity with which the Board of Woods and Forests rendered it possible to have this book published, is the best proof of a trend to raise sylviculture to the highest level; the finish of the work is a credit to the standard and good taste of the Agricultural Publishing House.

The work being long-needed in this field can be considered a great asset to Hungarian special literature, and is sure to have great success not only in forestry but also in the field of gardening and botany being also interested in woody plants, at home as well as abroad in spite of the bounds imposed by language difficulties.

Z. E. KÁRPÁTI

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SZ. SCHERMANN

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(Study of Seeds)

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This outstanding work of a pioneer character consists of four main parts. It contains the identification key of some 1800 plant species, and describes, in the following grouping, the fruits and seeds of 120 Hungarian agricultural, 100 horticultural, spice and pharmaceutical plants, further, some 50 exotic agricultural plants, 230 ornamental flowers, 110 home and 100 foreign trees and shrubs, 360 home and 100 exotic weeds, as well as 650 wild plants living in Hungary.

All the species treated are typified on the basis of symmetry relations, dimensions, surface and structural characteristics in a uniform system, and the groups delimited are supplied with specific identification keys. All in all, with species appearing in several forms and the border cases included, the author discusses some 2130 items.

The fundamental concerning fruits and seeds are included in Part One; Part Two presents the type systems together with the identification keys; Part Three describes the seed species and defines their systematic places; while Part Four gives a good illustrative material in tables, detail- and line drawings.

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